UNIVERSITY OF GHANA

COLLEGE OF HUMANITIES

TOWARDS THE TEACHING OF COMPUTER PROGRAMMING IN RURAL GHANA: TEACHER MOTIVATION, TOOLS AND POLICY. A CASE OF SENIOR HIGH SCHOOLS IN NORTHERN GHANA.

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THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MPHIL MANAGEMENT INFORMATION SYSTEMS DEGREE

JANUARY, 2023

DECLARATION

I do hereby declare that this work is the result of my research under supervision, and has not been presented by anyone for any academic award in this or any other University. All references used in the work have been fully acknowledged.

12 / 01 /2023

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ABSTRACT

The purpose of this research was to evaluate the effectiveness of Senior High School teachers in rural Ghana in the teaching of computer programming while considering the difficulties that policies and tools for teacher motivation present. Extant studies on the teaching of computer programming have largely focused on developed nations. Similarly to this, a close examination of the literature reveals that the majority of the experiences of computer programming in schools occur in western countries also referred to as Western, Educated, Industrialized, Rich, and Democratic (WEIRD) nations.

Additionally, many extant studies on computer programming have called for studies on the teaching of programming in rural developing economies like Ghana to help broaden the scope of the impact of the implementation of the subject in the Ghana Education Service (GES) since 2007. This study adapts the Fit-Viability theory, the quantitative methodology, and the survey approach to examine how computer programming is taught in rural Senior High Schools in the northern part of Ghana and the factors that negatively affect or influence teachers in these rural areas of the country.

The target population for this study was teachers in the five regions of the north namely: Northern, North East, Savannah, Upper West, and Upper East who are into the teaching of computer programming. After two and half months of data collection, one hundred and fifty (150) questionnaires were valid for statistical analyses.

To test the hypothesis, the Partial Least Squares Structural Model (SmartPLS-SEM) approach was used. The findings indicate that the task characteristics of teachers teaching computer programming in rural Senior High Schools in northern Ghana have a significant impact on teacher performance in the subject (CP). The studies also found that IT infrastructure is crucial in the delivery of lessons by teachers. Furthermore, the findings indicate that teacher motivation has a considerable impact on teachers' lesson delivery and performance. Additionally, the study concluded that favorable educational policies for rural Senior High Schools can result in optimal CP teacher performance. Similarly, economic conditions benefit teachers who teach computer programming in rural SHSs in northern Ghana. The current study contradicted the theory in terms of organizational support. This implies that, if the other factors mentioned above are improved, organizational support alone cannot affect the performance of teachers teaching programming in rural SHSs.

Moreover, some implication of the study is that the Ministry of Education (MoE), Ghana Education Service (GES), and other stakeholders or agencies involved in the education sector need to invest enough funds into computer programming education in rural areas of the country.

Lastly, the study recommends that future research studies on the teaching of computer programming should consider using a qualitative technique to extract interpretations and experiences to contrast with the results of this current study.

DEDICATION

This work is first and foremost dedicated to the Almighty God who granted me life, strength, and wisdom to enable me to carry out this study. I dedicate this work as well to my lovely wife (Mrs. Esther Biile Naanbir Abiam) and my wonderful children (Damian Abiam and Delores Abiam) and also to my late parents (Mr. Abiam Akafara and Mrs. Apempok Awaam Abiam) for their unflinching support, encouragement, prayers, and love.

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

CP:	Computer Programming
STEM:	Science, Technology, Engineering, and Mathematics
LOGO:	Language of Graphic Oriented
GES:	Ghana Education Service
MoE:	Ministry of Education
ICT:	Information and Communications Technology
SHS:	Senior High School
UNESCO:	United Nations Educational, Scientific Cultural Organization
OECD:	Organization for Economic Co-operation and Development
EC:	European Commission
CLT:	Cognitive Load Theory
FVT:	Fit Viability Theory
IT:	Information Technology
IS:	Information Systems
WEIRD	Western, Educated, Industrialized, Rich, and Democratic

CHAPTER ONE

INTRODUCTION

1.1. Research Background

Computer programming has recently risen to the forefront of many educational curricula around the world, even as its impact on our lives continues to alter the way we go about our daily lives, from the simplest of jobs to the most complex and unusual ones (Fang et al., 2022). Today's world depends on computer programming since it powers the operating systems of practically every gadget we use. Computers are given instructions in the form of software through various programming languages. Programming Languages (PL) bridge the gap between how machines and people "think." To think that we ever lived in a world without computer programming languages like Python, QBASIC, JavaScript, C, PHP, C++, and so on, is impossible to comprehend in today's society. Surprisingly, that was the world in which we lived until only around 1960 (Berssanette & de Francisco, 2021). Uzunboylu et al. (2017) defined computer programming as a problem-solving process of formulating, planning, and designing the solution, translating testing, and delivering the result. For a person to be proficient in programming, essential skills such as learning the language, composing new programs, debugging, understanding, reusing, and integrating existing programs are essential (Leonard et al., 2018).

Computer programming has an impact on every aspect of our lives. The importance of computer programming cannot be overstated, from commerce and entertainment to healthcare and communications to data science and information security, automatic checkouts in supermarkets and e-banking to purchasing a flight online and education (Garca-Pealvo, 2018). Business decision-making for all data, transaction, and customer service needs is heavily reliant on computer programming. As a result, Information Systems (IS) researchers are increasingly focusing on the factors that influence success in the strategic and innovative application of technology (Cárdenas-cobo et al., 2021; Berssanette & de Francisco, 2021), highlighting the significance of computer programming in IS.

Data from the United States Department of Labor's Bureau of Labor Statistics Occupational Outlook Handbook indicates that in 2012 alone, computer programmers held approximately 343,700 jobs in the United States (Cárdenas-cobo et al., 2021). The Bureau of Labor Statistics also reveals that "job prospects will be best for programmers who have a bachelor's degree or higher and knowledge of a variety of programming languages" (Ganta, 2014; BLS 2014; García-Peñalvo, 2018).

Studies show that computer programming is extensively used in education particularly in the advanced world as it synthesizes critical thinking and offers a broad canvas to the learner (Oroma et al., 2012; Grover & Pea, 2013; Chakraverty & Chakraborty, 2020). At the same time, it enables the student to sketch half-understood ideas and assemble the screen as a semi-concrete image of the mathematical structures he or she is building intellectually (Berssanette & de Francisco, 2021).

Similarly, knowledge of computer programming provides numerous benefits such as improving students' imagination and creativity, enabling both outcome and process-oriented thinking, motivating students to go to school and learn, and encouraging research (Cárdenas-cobo et al., 2021). Additionally, CP promotes knowledge internalization through long-term memory use and assists students in developing problem-solving, spatial thinking, and critical thinking skills (Avidov-ungar et al., 2022).

Furthermore, CP as noted by Suleman (2018) aids in the acquisition of learning habits for solving complex problems through the integration of small projects and the execution of product-oriented large projects. It also increases learning habits through collaborative work, learning skills, learning by doing, and learning. Last but not least computer programming improves collaboration and mathematical reasoning (Berssanette & de Francisco, 2021). Despite these advantages, the majority of students from rural underdeveloped social contexts with low socioeconomic levels do not fully benefit from their first programming experiences (Tondeur et al., 2018; Bose & Zaman, 2022).

In the last few years, particularly, during the 4th revolution, computer programming has been viewed as the "new Latin" at school for many years. For this reason, governments across the globe are continuing to work hard to promote programming education (Faridatul et al., 2012; Sangadah & Kartawidjaja, 2020). Through the Computer Science for All initiative, Former United States President Barack Obama assigned 4 billion dollars to develop computer programming education in the K–12 sector (Sangadah & Kartawidjaja, 2020). In Japan, computer programming is now a required course in all Japanese educational institutions

(Tripathi & Nasina, 2017). Ussiph (2018) investigated the teaching of computer programming in Belgium. The study reported a positive impact on the teaching of computer programming. In addition, computer programming competence was reported high in almost all schools in Europe (Tondeur et al., 2018; Sano, 2019). The Ministry of Education of the People's Republic of China has mandated that computer programming education be made compulsory in all high school curricula (Tripathi & Nasina, 2017; Sangadah & Kartawidjaja, 2020). CoolThink, a computer programming education initiative in Hong Kong, raised HKD 216 million (roughly USD 27 million) to develop programming resources and materials for the education sector for the teaching of computer programming (Bakar & Mukhtar, 2019).

Ussiph (2018) for instance, demonstrates how suitably an existing knowledge in programming can be applied to solve complex problems in Mathematics, Physics, and generally in Science, Technology, Engineering, and Mathematics (STEM) disciplines. Bakar and Mukhtar (2019) further cited the benefits of Language of Graphics Oriented (LOGO), which highlighted the opportunities LOGO could provide students to manipulate concrete instances of mathematical ideas, facilitate connections between concrete experiences, and more abstract mathematics as well as allow students to use mathematics in ways that are more personally meaningful to them. Yet, research confirms that students in rural schools in computer programming classes frequently struggle with one or more of the concepts necessary to succeed. The most worrying statistics come from introductory programming courses, where failure and withdrawal rates exceed 50% (Benton et al., 2017; Apeanti & Essel, 2021). According to Apeanti et al. (2021) and Avidov-ungar et al. (2022), the overall probability of passing a first introductory programming course the first time was 40% across all majors, with a 19.5 % initial failure rate and a 40.5 % withdrawal rate. The worldwide average pass rate of an introductory computer programming course is approximately 67.7% (Benton et al., 2017; Apeanti & Essel, 2021).

Their study (Benton et al., 2017; Apeanti & Essel, 2021) included 161 outcomes in introductory computer programming courses across 15 countries in 51 different academic institutions. It was estimated that more than two million students took introductory programming courses in 1999 (Oroma, 2012; OECD, 2019). There is not much evidence, though, to show that this situation has changed considerably in recent years. However, since the 1980s (Podojil & Cudlín, 1989; Sleeman 1986), problems with the teaching and learning of introductory programming have also been highlighted, and this has been a popular subject of ongoing research ever since (Tondeur et al., 2018; Tripathi & Nasina, 2017). The relevance of these problems was succinctly stated by Bergin and Reilly (2005): "It is well acknowledged in the Computer Science Education (CSE) community that students have difficulty with programming courses and that this can result in high drop-out and failure rates." Bennedsen and Caspersen (2007) estimate that 650,000 students, or 33%, failed or dropped out of their first programming course. These figures are a source of concern for computing professors all over the world.

Halili and Sulaiman (2019) in their research on computer programming in rural schools in Malaysia, revealed that the skills in computer programming are useful and have the potential to end the digital lack. Similarly, Lee et al. (2017) espouse that knowledge in this area is sparse. Interestingly, the ministry of education departments is offering a variety of amenities to improve the teaching of computer programming in their respective countries' and budgets have been set aside to provide the necessary equipment, tools as well as policies to enhance the teaching of computer programming (Halili & Sulaiman, 2019). Despite these efforts, there are still issues in most developing countries (Monk & Monk, 2007; Tondeur et al., 2018; Ullah et al., 2020; Leonard et al., 2018). Factors like shortage or non-existent technology facilities due to the high costs of ICT resources, skills deficiency, and inaccessibility of ICT resources, are critical issues rural schools face (Monk & Monk, 2007; Tondeur et al., 2018; Ullah et al., 2020).

One of the core aims of programming is to engage students to think computationally and acquire skills to develop solid solutions through an understanding of concrete problems using analytical and critical thinking (Bakar & Mukhtar, 2019). Additionally, the incorporation of computer programming via coding and robotics studies gives students an advantage in learning other disciplines like mathematics, and physics, among others (Tondeur et al., 2018; Ullah et al., 2020).

Tokarz and Malinowska (2019) provide compelling evidence in support of the importance of computer programming. Mweshi and Sakyi (2020) contend that CP can improve teaching and learning experiences. This suggests that the tendency for students to develop computational thinking — a multifaceted system of thinking abilities including data collection, programming, and data analysis is necessary for success in the digital era (Avidov-ungar et al 2022; Bose & Zaman. 2022).

When it comes to Africa, the story is not different. For instance, a study by Lee et al. (2017) in a rural village in South Africa, found that language barrier, shortage of equipment, lack of internet access, shortage of computer programming teachers and experts, inadequate access to hardware and software, and illiteracy were among factors that hindered the teaching of computer programming. Uganda faces similar issues such as economic uncertainties, improperly developed ICT infrastructure, high data costs, and unreliable electricity supply are some of the challenges that plague the country (Alturki, 2016; Tondeur et al., 2018).

In Ghana, for example, computer programming is not fully embraced in all schools, particularly in rural settings (Buabeng-Andoh, 2015; Bose & Zaman, 2022). Findings by Buabeng-Andoh,

(2015) indicate that computer programming is still taught at a low level. As a result, these rural schools have fallen short of the Sustainable Development Goals (SDGs) Goal 4 agenda "Education for All" set forth by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) (Ussiph, 2018; Bose & Zaman, 2022).

Since the computer programming course was added to the Senior High School (SHS) curriculum in 2008, it is crucial to evaluate its effectiveness, project viability, suitability for bridging the digital divide in Ghana's rural areas, and whether the necessary infrastructure is even in place to guarantee the project's objectives are achieved. Utilizing the fit-viability theory, this thesis conducts an empirical investigation of the aforementioned.

1.2. Research Problem

Although there have been studies on teaching computer programming in rural settings, the focus has largely been on developed countries (Umapathy & Ritzhaupt, 2017; Uzunboylu et al., 2017; Cárdenas-cobo et al., 2021; Apeanti & Essel, 2021), with little research on less developed economies like Ghana. That is, the majority of the experiences described in the literature take place in well-educated countries, also known as WEIRD countries (Western, Educated, Industrialized, Rich, and Democratic).

Bers (2018) bemoaned recent debates over teaching programming in rural schools, asserting that previous research on the teaching of computer programming in these rural areas has yielded inconclusive results. Consequently, future efforts will focus on large-scale localization initiatives using alternative methods.

Furthermore, programming has long been a persistent issue in computer science classes worldwide, particularly in rural settings. It has a high dropout and failure rate when it comes to learning how to program (Apeanti & Essel, 2021; Sangadah & Kartawidjaja, 2020). Though there are numerous tools available to assist in teaching and learning programming, the issues remain unresolved. Existing studies have also mainly focused on the adoption and implementation of the subject (computer programming) but shed little light on the fit and viability requirements and whether schools (rural SHSs) adhere to these requirements. That is, there is a lack of assessment of the performance of the subject (Sangadah & Kartawidjaja, 2020; Apeanti & Essel, 2021).

It is on these premises that this study seeks to identify the task and technology fit requirement and how viable it is based on its Economic factors, IT Infrastructure, and Organizational and Stakeholder readiness.

Based on several gaps identified in existing research on the teaching of computer programming in rural settings, the following can be summarized as the leading gaps:

i. Theory Gap: Relevant theories have been advocated to analyze the teaching of computer programming. Although FVT is widely used in IS literature, the emphasis has largely been on technology adoption. In this thesis, the FVT is used in a different way to evaluate performance.

ii. Methodological Gap: There has been recent discussion about teaching programming in rural schools, with some asserting that previous research on the topic yielded mixed results. To this end, this study will employ a different method.

iii. Issue Gap: Rather than focusing on overall performance, many studies on the teaching of computer programming have focused on adoption and implementation (Task-Technology Fit and Economic, Organizational, and Infrastructural Viability). Furthermore, computer programming education, particularly in rural senior high schools, needs to be re-evaluated over six decades after its inception in Africa.

iv. Context Gap: Existing research on the teaching of computer programming in Ghana is relatively scarce. In the teaching of computer programming, Europe, America, and Asia have dominated. As a result, this study conducts a longitudinal investigation in Ghana.

1.3. Research Purpose

The study aims to investigate the fit and viability of the teaching of computer programming in rural Senior High Schools in Ghana.

1.4. Research Objectives

1. Investigate the fit and viability characteristics of the teaching of computer programming in rural Senior High Schools in northern Ghana.
2. To assess the level of teacher motivation towards the teaching of computer programming in rural Senior High Schools in northern Ghana.
3. To examine the effectiveness of the policies in the teaching of computer programming in rural Senior High Schools in northern Ghana.

1.5. Research Questions

1. How fit and viable is the teaching of computer programming in rural Senior High Schools in northern Ghana?
2. What is the level of teacher motivation towards the teaching of computer programming in rural Senior High Schools in northern Ghana?
3. What is the effectiveness of the policies in the teaching of computer programming in rural Senior High Schools in northern Ghana?

1.6. Significance of the study

This study is important for three reasons, namely its contribution to research, policy, and practice. The findings of this study will contribute to the extant conceptual and empirical literature on computer programming and serves as a foundation for additional studies.

In terms of policy, the results of the fit and viability analysis of teaching computer programming in rural settings would serve as a framework or road map for all stakeholders, including governments, the Ministry of Education, policymakers, and curriculum developers, to help them be aware of the unique challenges associated with the teaching of computer programming in rural settings, so the appropriate strategy could be put in place to address the digital divide in these areas.

Concerning practice, the findings of this research will be useful on a global scale, to educational partners such as the United Nations Educational, Scientific Cultural Organization (UNESCO), Organization for Economic Co-operation and Development (OECD), European Commission (EC), and other multi-national agencies who are indispensable contributors to the success of education in developing countries.

1.7. Chapter Outline

The thesis is arranged into seven (7) chapters. Chapter one introduces the study by presenting the background of the research, research problem, research purpose, as well as objectives of the study, was discussed. Furthermore, the research questions, the significance of the study, and the organization of the entire research.

Chapter Two: Literature Review; this chapter reviews relevant literature to the study.

Chapter three: A research framework and hypothesis development; focus on the theory used and associated hypothesis development are presented. Additionally, there is a justification for the model adopted in this study.

Chapter four: Research methodology; presents the methodology adopted in this study, which includes research paradigm, research methods, population and sampling technique, data collection, and the method of data analysis.

Chapter five: results and analysis; focuses on the findings and analysis of the study; the chapter presents the results of the study, which include; demographic characteristics of the respondents, together with data presentation, and analysis of the findings of the study.

Chapter Six: discusses the results that were obtained from the analysis of the findings to unearth dominant themes arising from the findings in chapter five as well as a discussion of findings to answer the research questions modeled in chapter two.

Chapter seven: is the concluding chapter, which produces a summary of the purpose and objectives of the study, the major findings, and conclusions. The chapter communicates the implications of the study conducted as well as the directions for future research. Finally, references and appendices

CHAPTER TWO

LITERATURE REVIEW

2.1. Chapter Overview

This chapter provides a review of related literature on the thematic areas, the concepts relevant to the study, and the evolution of Computer Programming. The chapter further reviewed the theoretical and conceptual framework underpinning the study. The chapter also did an empirical literature review on the teaching of computer programming in Ghana given the adoption of the subject in rural second-cycle schools in Ghana, and finally, a summary of the literature reviewed.

2.2. Definition of Key Terms

2.2.1. Computer Programming

The term Computer Programming (CP) has been widely defined by different scholars in Computer Science (CS) and Information Systems (IS). For instance, Graham et al (1989), Salim et al (2010), Grover and Pea (2013), Uzunboylu et al (2017), and Leonard et al (2018) see CP as the process of designing, writing, and testing, debugging and maintaining the source code of computer programs. CP involves the process of writing instructions to guide computer operations. This was captured sufficiently by Berssanette and de Francisco (2021) who defined the term CP as a set of instructions written in a specific computer programming language (PL) for specific computer architecture. From these definitions, it can be stated that there is no specific universally accepted definition of CP. Therefore, for this thesis, CP is "a process of writing computer codes to facilitate specific actions in a computer, application or software program, and instructs them on how to perform". The tasks could be as simple as adding two numbers or rounding off a number, or slightly complex, like calculating simple interest, or calculating the average return on a stock average return over the last five years (Leonard et al., 2018).

Programming language (PL) is a language used to write computer programs (Association of Computing Machinery Special Interest Group Programming Languages (ACM SIGPLAN, 2003). As noted by Leonard et al (2018) PL permits humans to communicate with machines. There are several programming languages with different modes and order of composition (e.g. C, C++, Java, Python, Visual Basic, FORTRAN, etc) (Berssanette & de Francisco, 2021).

Table 2.1 summarizes various definitions of computer programming by different authors.

Table 2. 1 Definition of Computer Programming

Author (s)	Definition
Berssanette and de Francisco (2021)	Computer programming is a set of instructions written in a specific computer programming language for specific computer architecture. Or It is the process of writing instructions to guide computer operations.
Uzunboylu et al. (2017)	Computer programming is a set of instructions for facilitating specific actions. Programmers write codes that tell a computer, application, or software program how to work.
Leonard et al. (2018)	Computer programming is a problem-solving process of formulating, planning, and designing the solution, translating testing, and delivering the solution. For a person to be proficient in programming, essential skills such as learning the language, composing new programs, debugging, understanding, reusing, and integrating existing programs are essential.
Mandell (1986)	Computer programming is the process of designing, writing, testing, debugging, and maintaining the source code of computer programs. This source code is written in one or more programming languages. The purpose of programming is to create

	a program that performs specific operations or exhibits a certain desired behavior. The process of writing source code often requires expertise in many different subjects, including knowledge of the application domain, specialized algorithms, and formal logic.

Source: Author 's Construct

2.2.2. Algorithms

According to Bers (2018) algorithms are the use of a sequence of steps to obtain a solution. For instance, writing code for a program that calculates one's income tax requires a sequence of steps (algorithm): to sum a taxable income, subtract a deductible spending, and compute payable tax based on a specific tax rate. In the context of CP, debugging is the process of analyzing and determining which parts of a solution produce incorrect results (Umapathy & Ritzhaupt, 2017; Akinola & Nosiru, 2014). This process in CP refers to locating and fixing parts of a program that do not meet the program's intended specifications.

syntax

The term *syntax* has been variedly defined in both CS and IS disciplines but the commonest and generally accepted definition is one given by Armstrong and Sambamurthy (1999) and Scott (2000) as the structural rule of a PL. It is considered the "grammar" of a PL. It thus means that syntax implies a set of grammatical rules. The syntax is therefore the foundation of a PL where both the programmer and the computer depend on a common set of understanding of what a piece of code means (Wang et al., 2017; Park et al., 2017). The use of the term connotes a clear understanding of what a piece of code means when writing a program.

Syntax Errors

The idea of syntax errors is extensively used in CP and it is applied in various PLs. The term syntax errors ensue when a programmer writes code that does not conform to the language rules of the parser (Uzunboylu et al., 2017; Leonard et al., 2018). It could be as simple as the omission of a semi-colon at the end of a sentence. An important goal of CP is to assist students in developing skills in syntax to avoid these mistakes when programming. That is for analyzing codes to limit the number of errors during programming (Bakar & Mukhtar, 2019; Alturki, 2016).

2.2.3. Computational Logic

The ability to generate programs that perform useful tasks refers to as Computational logic (Atmatzidou & Demetriadis, 2016; Demirer & Sak, 2016; Deng, Benckendorff & Gannaway, 2019). For instance, the, if...else control statement in programming languages, is a common type of computational logic. For instance, if variable *y* is greater than variable *z*, then output the sentence *"y* is greater than *z*"; otherwise, if variable *y* is equal to variable *z*, then output the sentence "*y* and *z* are equal." The statement below illustrates how the "if…else" statement works in the python programming language.

```
if y > z:
    print ("y is greater than z")
elif y == z:
    print ("y and z are equal")
```

Similarly, different programming languages can express the same set of computational logic to perform tasks under different conditions. For example, C++ and Python may produce different syntax but the output is the same.

for loop in C++ programming language:

```
for (int i = 0; i < 5; i++) {
    cout << i << '\n';
}
```

for loop in Python programming language:

```
for i in range (0, 5, 1):
    print(i)
```

The numerical sequence produced by both programs is the same (from 0 to 4). Precisely, when first amateur students recognize the fundamental principles of computational logic, they can apply that knowledge to another programming language by learning the new syntax. However, beginner programmers interpret the syntax of some programming languages to be simple to digest and analyze, as well as more intuitive to write (Podojil & Cudlín, 1989; Pollak et al., 2019; Silva et al., 2020).

2.2.4. Remixing Codes

Remixing in the context of CP is a concept that describes the process of modifying existing codes to create a new program (Dufva & Dufva, 2016). Uzunboylu et al. (2017) perceive remixing as the ability of a programmer to cut, copy, and paste a preceding code used earlier. According to Graham et al. (1989) and Salim et al. (2010) remixing is a useful technique that serves as a scaffolding tool for beginner programmers to easily comprehend CP codes. This definition implies that students can improve their ability to interpret syntax and analyze computational logic from programming codes by altering existing codes to generate programs that meet their personal needs. As noted by Leonard et al. (2018) learners can work together to iteratively and incrementally build a small block of codes, and assist one another in revealing problems in the programming code.

2.2.5 Computational Thinking

Computational thinking reflects a systematic approach to solving problems. This concept was coined by Wing (2006) who defined computational thinking as “solving problems, designing systems, and understanding human behavior, by drawing on the concepts fundamental to computer science”. Based on a seminal review of 70 research papers on the topic, Kanika et al (2020) and Shute et al (2017) expounded computational thinking as "the conceptual foundation required to solve problems effectively and efficiently (i.e., algorithmically, with or without the assistance of computers) with solutions that are reusable in different contexts". These definitions emphasize that computational thinking is first and foremost way of thinking and acting that can be demonstrated through the application of specific skills, such as computer programming. Pollak and Ebner (2019) also summarized four computational thinking components that are frequently discussed in the literature: decomposition, abstraction, algorithms, and debugging.

Decomposition is defined as the process of breaking down a problem into smaller parts (Wing, 2006; Pollak & Ebner, 2019). That is the process of breaking down a large program into smaller, more manageable components for programming. According to García-Peñalvo (2018), abstraction is the process of formulating general concepts by extracting common properties or features from specific examples. An example of coding abstraction is the packaging of frequently used sets of program codes into functions that can be used anywhere in a program as many times as needed.

2.2.6. Machine Language

Machine language, also known as machine code or object code, is a collection of binary digits or bits that the computer reads and interprets (Luxton-reilly et al., 2019). Machine language is the only language that a computer can understand. The precise machine language for a program or action can vary depending on the operating system. The way a compiler writes a program or action into machine language is determined by the operating system (Cárdenas-cobo et al., 2021; Faridatul et al., 2012). Programming languages like QBASIC, C++, Java, Visual Basic, and others are used to write computer programs. Since a computer is incapable of understanding natural language the program code must be compiled and converted into machine language.

2.2.7. Rural Areas

A rural area is a term that has no universally accepted definition (Monk & Monk, 2007; Lee et al., 2017; Fogleman, Mueller & Jenkins, 2015; Blake, 2017; Bennet et al., 2019; Zahnd et al., 2019). According to the Ghana Statistical Service (2021), a rural area is defined as a town or village having a population of fewer than 5,000 people. Rural areas are defined by Ong Tze San (2013) and Malaysia's National Statistics Department (2013) as gazette areas with low urban expansion and a population of fewer than 10,000 people. The rural community is frequently referred to as impoverished. Although poverty exists in cities as well, rural issues are more frequently brought up in discussions (Hatta & Ali, 2013; Bennett et al., 2021). According to research (Hatta & Ali, 2013), a rural community is made up of people who live in poverty and lack access to basic amenities such as good roads, electricity, portable water, good hospitals, good schools, and so on.

In the US, between 46 and 59 million Americans (15%–20% of the population) live in rural areas. Population counts and proportions vary based on the definition of "rural" and the geographic units utilized (Drescher et al., 2022). There are 15+ federal definitions of "rural"; most consider some combination of population size, proximity to urbanized or metropolitan areas, and commuting patterns, and use countries' ZIP codes, or census tracts as their geographic unit (Monk & Monk, 2007; Drescher et al., 2022). However, measurement inaccuracy, the modifiable areal unit problem (i.e., varying findings depending on the size and form of geographic boundaries), and validity issues frequently plague these definitions (Drescher et al., 2022).

Table 2. 2 Rural Line Definitions, by Country

COUNTRY	DEFINITION	SOURCE
CHILE	Rural areas are defined as places having low population density, primarily extractive activities, and a population between 1,001 and 2,000 people.	http://www.ine.cl (last accessed May 25, 2022).
LITHUANIA	Rural area refers to persons living in residential areas lacking urban characteristics (small towns, villages, isolated farmsteads).	http://www.stat.gov.lt (last accessed May 25, 2022).
BANGLADESH	Rural area definitions for Bangladesh come from the Bangladesh Bureau of Statistics (BBS). The BBS defines a rural area as an underdeveloped area with the following characteristics: (i) an identifiable scattered settlement, (ii) social amenities like metalized (paved) roads, communication facilities, electricity, gas, water supply, and sewerage connections usually do not exist, and (iii) which is less densely populated and a majority of the population involved agricultural occupations.	http://www.unescap.org (last accessed May 25, 2022).
BRAZIL	A rural area is defined as the area of a municipality located outside the urban perimeter.	http://www.ibge.gov.br (last accessed May 25, 2022).
GHANA	Ghana Statistical Service defines a rural area as a town/community with a population of less than 5,000. All other areas are considered urban.	http://www.statsghana.gov.gh (last accessed May 25, 2022).

Source: Author's construction

2.2.8. Motivation at the Work Place

Various explanations associated with employee motivation, including expectancy theory (Vroom, 1964) and Maslow's hierarchy of needs (Maslow Abraham, 1954), have both been linked to efforts to increase productivity and the quality of work experiences. Motivational psychologists extricate between those activities that are intrinsically motivated (i.e., performed voluntarily and without reward) from those that are extrinsically motivated (i.e., performed for an external reward). A crucial challenge for school design is considering how intrinsic and extrinsic motivation might work together (Vroom, 1964; Maslow Abraham, 1954) note that "... even if a program is educationally sound in every other regard, its degree of success or failure often rests on the hygienic aspects affecting the whole learning environment."

Herzberg's seminal work from the 1950s (Ghazi et al., 2013) served as the foundation for one influential framework that has been used to investigate the motivation of programmers and software engineers. Ambrose and Kulik report that the actual link between motivation and performance has been little studied (Hur, 2018). Herzberg discovered through empirical research that the causes of job satisfaction (and motivation) are distinct from those that cause job discontent; pleasure and dissatisfaction are not opposed emotions.

The Motivation-Hygiene Theory, developed by Herzberg, distinguishes between "motivator factors" and "hygiene factors." Motivating factors are inherent in the work to be completed and are the main source of satisfaction (e.g., achievement, recognition for achievement, the challenge of the work itself, responsibility, growth, and advancement opportunities). The biggest source of discontent is when they are lacking in hygiene considerations, which are external to the work itself (e.g., company policy and administration, supervision, interpersonal relations, working conditions, salary, status, and security). Hygiene variables are hence sometimes to as dissatisfaction avoidance factors.

Herzberg noted that while numerous tweaks to work tasks or workplace conditions improved employee satisfaction, they infrequently produced the predicted increases in motivation (performance). Employee behavior was motivated by an outside stimulus, which leads to a transient shift in attitudes that needed external inputs to stay in place. These tweaks successfully incorporated hygiene considerations into a working environment that had previously been absent.

The basic concepts of Herzberg's Two-Factor Theory have greater universal applicability to different situations, despite being focused on employee motivation and relevant to the work environment. The result is that a composite of many aspects needs to be considered when the goal of any enrichment program is to promote satisfaction and reduce unhappiness. Hygiene concerns must be handled systemically and continuously if we want to lessen unhappiness. Motivator aspects must be gradually added to raise satisfaction.

Within the computer science education community and its related literature, there is considerable discussion over how to plan and conduct effective teaching of a computer programming course. The selection of the programming language and the timing of object instruction are major topics of discussion (Mweshi & Sakyi, 2020), as well as determining the variables that are most likely to predict a teacher’s delivery success in a course like this, such as the teacher’s self-efficacy, the mental model of programming, intrinsic motivation, math background, teaching style, etc. (Siponen and Tsohou, 2018; Brierley 2017; Gamlen & McIntyre, 2018; Rahi, 2017; Mweshi & Sakyi, 2020). Almost all of the conversation in this context focuses on the course's actual content and on what Herzberg would call motivating elements. Less focus has been placed on supporting the larger environment where these motivators can develop and where the content can thrive.

Ab Hamid et al (2017) state that the institution, competent teachers, infrastructure (i.e., laboratories, classrooms, and a collection of useful software tools), as well as industry involvement to keep the curriculum up to date and relevant, are all necessary for an educational program to be successful.

2.3. The Evolution of Computer Programming

Computer Programming was first developed in the 19th century (1883) by Ada Lovelace and Charles Babbage who worked together on an Analytical Engine which was a primitive mechanical computer (Gomes & Mendes, 2007; Munson & Zitovsky, 2018). They later realized that CP could be performed more than just numerical values (Munson & Zitovsky, 2018). In the 1950s, the University of Cambridge in the UK advanced the teaching of computer programming in computer science programs where students required a thorough understanding of CP to operate the Electronic Delay Storage Automatic Calculator (EDSAC) machine (Davenport, 2018; Graham et al., 1989). Since then, beginning in the 1960s, computer programming has been gradually institutionalized throughout the US educational system and around the world, and at the same time, the popularity of various programming languages such as FORTRAN, Assembly, and ALGOL (an early originator of C++ and Java) soared (Park et al., 2017; Silva et al., 2020).

Between the 1970s and 1980s, as the owner of personal computers improved in schools and educational programming languages were taught in many classrooms globally, the LOGO and QBASIC programming languages were adopted for Commodore 64, Atari, and Apple II computers in the 1980s. Students used these languages to generate interactive outputs with just a few lines of code, even if they had no prior knowledge of computer hardware or operating systems (Dietz et al., 2019).

In the late 1980s and early 1990s, many commercial software packages including Graphical User Interfaces (GUIs) for computer programming purposes began to soar due to the advancements in the operating system and computer hardware design (Becker & Quille, 2019; Gomes & Mendes, 2007). For example, the Scratch and QBASIC programming languages developed into Visual Basic after several adaptations, enabling beginners to quickly generate window applications using its GUI (Park et al., 2017; Silva et al., 2020), and the traditional programming languages were also evolving at the same time. Additionally, user-friendly programming environments with GUIs were created using the C++ and Java programming languages. In such coding environments, programming libraries or reusable programming resources had become easily accessible. As noted by Silva et al (2020), this resulted in a shift in how amateurs learned to program using self-study books like Teach Yourself Java in 21 Days.

Today, Visual programming such as Prograph, Pict, Tinkertoy, Fabrik, CODE 2.0, and Hyperpascal have proven to be more intuitive to learn than textual programming languages (e.g., Python and C++) because they help rule out a large class of syntactic mistakes commonly made by novices of textual programming languages (Luxton-reilly et al., 2019). Beginners are increasingly interested in visual programming such as Scratch and Alice for block-based languages that allow them to create computer programs (Bakar & Mukhtar, 2019).

2.4. Empirical Review

In recent years, several empirical studies on IS and the teaching of computer programming in rural settings have been conducted (Suleman, 2018; Nelson & Ko, 2018; Cheah, 2020; Fang et al., 2022; Al-emran & Shaalan, 2021;). Studies conducted by Nelson and Ko (2018) indicate that countries globally are struggling with the implementation and teaching of computer programming in rural schools. This phenomenon is very common in Sub-Saharan Africa (SSA) and Central America rural SHSs (García-Peñalvo, 2018; Halili & Sulaiman, 2019; Park et al., 2017; Munson & Zitovsky, 2018; Nelson & Ko, 2018). Statistics show that failure and withdrawal rates in CP exceed 50% (Ussiph, 2018; Yoo & Kim, 2018; Yoo & Kim, 2019 Fang et al., 2022).

According to Apeanti et al. (2021) and Avidov-ungar et al (2022) the overall pass rate of CP the first time was 40% across all majors, with a 19.5 % initial failure rate and a 40.5 % withdrawal rate. The worldwide average pass rate of an introductory computer programming course is approximately 67.7% (Nikula et al., 2011; Oroma et al., 2012; Leonard et al., 2018).

In all, a total number of 15 countries in 51 different academic institutions were purposefully selected and interviewed. Structured and semi-structured questionnaires were used to collect data.

A study was done in rural Saudi Arabia, and the researchers used Bloom's cognitive levels assessment criteria to guide their research (Ullah et al., 2020). The researchers found that fundamental topics of structural programming were problematic. The data was collected from 213 students using an empirical test, which was analyzed using Structural Equation Modeling (SEM). The findings indicate that Bloom's taxonomy is a useful tool for learning and evaluating programming. This is largely in response to the transformation and development of society through programming (Sangadah & Kartawidjaja, 2020). Ghana, like many other African countries, share similar characteristics among rural schools. For instance, an investigation into the effect and the use of 3D interactive animation tools in teaching computer programming at the senior high school level in Ghana was conducted (Ussiph, 2018). This study adopted a quasi-experiment to determine the aptness of 3D animations as an instructional method to introduce programming concepts. The data was obtained from 100 students of Akroso Senior High School in the Birim central municipality of the eastern region of Ghana who were generally programming novices. A paired t-test was used, and the result of the performance test was a p-value of 0.008. This study showed a statistically significant difference between the mean marks of participants from rural schools and their counterparts in the urban cities during the experiments that used 3D animation in the teaching of computer programming. The study further revealed that there is a huge gap in the teaching of computer programming in urban and rural locations. In addition, programming skills among teachers were reported low. This study is significant because it will help establish and build the best policies for rural areas. To increase the teaching of computer programming in rural regions, the authorities must first prepare the appropriate activities before taking any action.

According to the Malaysia Ministry of Education 2016 report, the teaching of computer programming was implemented in all government schools in 2012 as part of the Malaysian Education Development Plan from 2013 to 2025 (Wijtzes et al., 2016). In line with this, the establishment of the Smart School program in 1999 was instituted with the expectation of bringing about wide-scale teaching of computer programming in their educational system. It was anticipated that this action will eliminate the digital divide in all rural schools/communities. In a related study by Umapathy and Ritzhaupt (2017), computer programming skills were found to be the primary determinant among Malaysian secondary school students in rural areas. Cárdenas-cobo et al (2021) sustain that if a teacher lacks the proper resources for both teaching and learning, teaching computer programming will continue to be unsuccessful. When it comes to the number of studies about novice and expert learners from introductory programming, a very recent work, Wijtzes et al (2016), explain that we know very little about effective and ineffective behaviors of novice students in computer programming, especially how effective behaviors can be identified and whether they can be used to improve the learning process of the ineffective learners.

Leonard et al (2018) did a cross-sectional study to empirically validate stated hypotheses, gathering 1101 responses from three different computer science courses and analyzing them using the structural equation model (SEM). The researchers inspected students' time and code-size data and found that students who achieve better grades start and finish assignments earlier than students with worse grades. In addition, successful novice programmers moderately wrote more program code. Although this study has analyzed an extensive sample, they inspected just a few features.

Another study conducted by Luxton-reilly et al. (2019) indicates that there is a statistically significant positive association between the teaching of computer programming in both remote and urban areas. Recently, these kinds of analyses have been arousing the interest of researchers. For example, Park et al (2017) and Nikula et al (2011) use code metrics, such as the number of submissions, time spent programming, temporal patterns, number of syntactic errors, a.o., to estimate students' outcomes, using varied machine learning and data mining techniques.

Still, Hatta et al (2013) and Larosiliere et al (2016) performed a formative assessment of programming students by assessing how 101 novices develop their code over time to explore problem-solving paths. Lee et al (2017) investigated a small dataset of 15 programming students collected from what they called intelligent teaching assistants for programming to generate automatic hints. Both works are much smaller scale however, they support the previous studies as crucial for a better understanding of the teaching of computer programming.

Ganta, (2014) and García-Peñalvo (2018) proposed an algorithm called Error Quotient (EQ), which uses snapshots of compilation to quantify the student errors while they are programming. The EQ algorithm receives as input a pair of compilation events and assigns them a penalty if both events ended with an error. The penalty could vary, eg, whether or not the error of both compilation events was the same. Alturki (2016) extended EQ with an algorithm to compute the Watwin Score (WS), which scores compilation pairs, by additionally considering the problem-solving time in remote areas.

Considering learning analytics in the context of computer programming in rural settings to model students' behavior and teachers' perceptions towards the teaching of computer programming, studies have explored the compilation errors (Akinola & Nosiru, 2014; Alajmi et al., 2017; Alturki, 2016) how teachers deal with the difficulties in teaching computer programming (Monk & Monk, 2007; Park et al., 2017; Munson & Zitovsky, 2018; Nelson & Ko, 2018), how many attempts they need to solve the problems (Munson & Zitovsky, 2018; Nelson & Ko, 2018), how they use hints in a web-based system (Alajmi et al., 2017), which are their frequencies of submission and unique attempts (Munson & Zitovsky, 2018), how much effort students put into writing programming (Shute et al., 2017), and which is their typing pattern and keystroke latency when programming (Shute et al., 2017; Munson & Zitovsky, 2018). All these studies analyze the relationship. However, there has not been found to have a significant impact on the teaching of CP in rural settings and on students' behavior during programming (Wang et al., 2017). Hence, one important contribution of this work is to show, through our case study, how important it is to measure, collect, analyze and report the findings of teacher motivation tools and policies that support the teaching of computer programming in rural settings.

Pereira et al. (2020) investigated students' behavior in introductory programming in rural settings in Brazil. The researchers deployed CodeBench for 3 years (2016–18) and collected data from 2058 students from 16 introductory computer programming on which they carried out fine-grained learning analytics, towards early detection of effective/ ineffective behaviors regarding learning computer programming in Brazil. The findings revealed that students' behavior while programming had influenced learning outcomes. Furthermore, the findings highlighted novice students' behaviors that can be used to help them enhance their learning performance, which can be used to develop interventions.

Another study by Munson and Zitovsky (2018) looked at a content analysis of CP studies in rural Turkey, and the second looked at a generic examination of countries that have integrated CP instruction into their curricula. According to the findings, many countries have re-examined their curriculum to include CP in it. CP is taught in national or regional curricula in 16 of the 18 nations studied (Austria, Bulgaria, Czech Republic, Denmark, Estonia, France, Hungary, Ireland, Israel, Lithuania, Malta, Spain, Poland, Portugal, Slovakia, and the United Kingdom). The researchers used quantitative methodologies in this study, with data acquired mostly through literature reviews and scale/survey interval procedures. Additionally, the investigation was primarily focused on the subjects of "programming" and "Scratch", the terms programming and coding were used as synonyms.

In a study on programming education in rural settings around the world and in Turkey, Yoo and Kim (2019) found that programming education has been introduced as a primary school curriculum both globally and in Turkey, and that students begin writing codes at a young age will be able to design their projects and applications in the future. To this end, the researchers argue that future programmers will be born and that these programmers will have an impact on their countries' development.

An assessment of the distribution of CP education studies done in Turkey by year reveals that the number of CP education studies in rural areas grew between 2014 and 2016 when compared to 1997-2007. Four studies were published in the first 10 years, whereas 35 were published in the last ten years. When the subject distribution of CP education studies in Turkey was analyzed, it was determined that the subjects of CP education studies were algorithms, computational thinking, code, robot programming, Scratch training, and most programming (Ussiph, 2018; Yoo & Kim, 2018; Yoo & Kim, 2019 Fang et al., 2022).

2.5. Review of Literature on the Teaching of Computer programming

According to Creswell (2007) and Boateng (2016), literature reviews undertaken during research allow the researcher to address unresolved issues, fill research gaps, discover a basis for a research topic, and provide justification for the choice of a research approach. A literature review also aids in the identification of research concerns that need to be discussed or researched to find solutions, as well as providing a wide picture of existing information.

The literature review can be done in five stages (Boateng, 2016). These five phases include (1) classification of the literature, (2) theories applied, (3) context of research and methodological approach, (4) focus or technology adopted, and (5) research gaps or issues. The following sections follow Boateng (2016) approach to a review of the literature. The review consists of 13 selected articles shown in Table 2.3.

Table 2. 3 Summary of Selected Studies on Computer Programming

Author (s)	Focus or Purpose	Methodology & Country	Theory/Model Used	Issues/Gaps Identified for Future Research Areas
Suleman (2018)	To understand the issues and difficult topics that beginners face when learning to code.	Mixed Methods Kenya and South Africa	No Theory/Model	The results of the research reported in this paper were based on surveys and interviews with moderately small sample size. Second, it failed to consider student perspectives. It may not be possible to infer cause-and-effect relationships between problem-solving and recursion unless a large-scale controlled experiment is conducted.
Fang et al. (2022)	Students from underdeveloped areas have a weak foundation for solving math and physics problems, making learning programming difficult even in university settings.	Quantitative Ecuador	No Theory/Model	Future research will focus on addressing the study's limitations and determining whether the findings can be applied to a larger group of students.
Nelson & Ko (2018)	The application of theory to explain learning phenomena and improve designs, thereby limiting our impact in both endeavors • The	Conceptual Paper	Cognitive Load Theory	Qualitative research into why papers are rejected for publication, employing best practices such as using multiple raters, calculating inter-rater reliability, and blinding the reviewer and the paper under review.

	value of domain-specific theory about computing content in accelerating design. • Bias in peer review of designs by using theory as a critical lens, preventing both theory evaluation and the search for better designs.			
Saleem, Lajis, Jamjoom and Altalhi (2020)	The study loos Bloom's taxonomy: A useful tool for learning and assessing students' computer programming competency levels.	Quantitative Saudi Arabia	Bloom's cognitive levels and proposed assessment criteria	In the future, the criteria for assessment should be enhanced to assess the student's competency level in advanced topics of computer programming.
Uzunboylu, Kınık and Kanbul (2017)	The first purpose is to conduct a general analysis of countries that have integrated coding training into their curricula, and the second aim is to conduct a content analysis of studies on coding training in Turkey	Qualitative Turkey	Descriptive Survey Model	Future research should focus on experimental studies in the field of computer programming education.

Alturki (2016)	Examine the factors that influence student performance in an introductory programming course (CS1), to discover correlations between various assessment methods, students' participation, and their final grade.	Quantitative Saudi Arabia	No Theory/Model	Future research should expand on how students' motivation for programming at Al-Imam University influences their performance. In addition, future studies should look into whether programming course grades and deviations differ by gender.
Luu, Yendok and Ansoglenand (2019)	This research was conducted to assess the feasibility of adding computer coding to the Basic level curriculum of the Ghanaian Education System.	Mixed-Method Ghana	No Theory/Model	The sample frame restricted prospective responders to school leaders, ICT tutors, and students. To make future studies more representative, the sample size should be increased.
Turci, Fogli and Malizia (2019)	This work focuses on a game-based approach to foster Computational Thinking skills, and gameplay as an effective way to foster the learning of Computational Thinking skills?". 1. Can we provide a playful way of	Quantitative UK	No Theory/Model	Future studies should concentrate on the concept of engagement and how to drive engagement in mastering CT skills via TAPASPlay.

	learning CT skills? 2. Can collaborative learning help to improve CT skills?			
Pereira et al (2020)	This paper focused on how CodeBench an Online Judge collects fine-grained data on student actions such as keystrokes, submission count, and grades.	Quantitative Brazil	Fine-grained data learning analytics methods	Future research should look into how the data-driven methods used in this work might be applied to model students who begin the course with successful behaviors but later develop failure behaviors and grades.
Nikula, Gotel and Kasurinen (2011).	This paper focused on Lappeenranta University of Technology (LUT) between 2005 and 2009 to rehabilitate a difficult first programming course with 157 to 249 students enrolled annually.	Mixed-Method Finland	Grounded Theory, Two-Factor Theory & Theory of Constraints (TOC).	A future study should examine the larger impact of programming thinking on their overall studies, potential employment careers, and everyday life.
Knutas, Roy, Hynninen,Granato, Kasurinen & Ikonen (2019).	This paper outlined a method for creating supervised machine learning algorithms that enable the selection of	Quantitative	Design Science Research and abstract design knowledge Framework.	Future work should involve testing in a diversity of situations and feedback from design teams that establishes the benefits of using the process in various design situations and the suitability of

	customized gamification features for each type of user based on their profile and the system context.			using machine learning-based algorithms in gamified systems.
Oyelere et al (2016)	This paper examined the level of readiness and suitability of mlearning to support the learning of ICT among primary and secondary school students in Nigeria	Quantitative Nigeria	Design Research Method (DRM) & Cloud-Based M-Learning Model	Future research should focus on the impact of the learning model in Sub-Saharan Africa and critically evaluate the teacher's role in mobile learning.
Benton, Hoyles, Kalas, Noss (2017)	The study focused on the relationship between learning to program and learning to represent mathematical ideas through programming.	Mixed Methods England	Randomised Control Trial Mode	Future studies should include a theoretical lens to ensure that the findings apply to a larger population.
Cárdenas-Cobo et al.(2021)	The main objective of this research was to test whether the use of Scratch can improve the learning outcomes of undergraduate students from	Quantitative Ecuador	Cross-Sectional Paradigm	Future studies will aim at testing the technological acceptance of Scratch by students and teachers. Also, to develop a study based on existing technology acceptance models to understand the determinants of such acceptance.

	communities that historically perform poorly.	

Source: Author's construction

2.6. The Teaching of Computer Programming in Selected Countries (Rural Areas)

Almost all rural communities throughout the world struggle with the teaching of computer programming and have been unable to reap the myriad benefits (Suleman, 2018). Fang et al. (2022) identifies limited ICT infrastructure, inability to purchase ICT equipment, and inadequate teacher expertise in computer programming as challenges experienced by rural areas.

Many studies have found that during programming lessons, both teachers and students in remote areas face a variety of challenges (Suleman, 2018; Fang et al. 2022). Fang et al. (2022) bemoaned the lack of appropriate IT infrastructure. Similarly, Anyango and Suleman (2018) expressed worry about the obstacles to the successful teaching of computer programming in rural communities. The findings by Halili and Sulaiman (2018) identified several gaps, issues, and roadblocks that have arisen as a result of the implementation of the teaching of computer programming in rural areas around the world. However, these findings were silent on the teachers who teach the course, teacher motivation tools, and policy.

The digital gap in rural areas, according to Watson (2014) and Wickramasinghe (2018), is a big worry for many countries around the world. Watson and Wickramasinghe hold the opinion that computer programming expertise will increase rural populations' possibilities for growth. According to Ullah et al. (2020), computer programming abilities have a significant influence and are essential for the rural community's economic development.

Further, Umapathy and Ritzhaupt (2017) coincide that most countries all over the world have taken the opportunity to widen their skills in computer programming for rural community development. (Halili and Sulaiman, 2019) regard computer programming as a key skill for the economic modernization of a country's rural community as it strengthens the economic, financial, marketing, social, and political resources, the key to success and development in today's world of work.

2.6.1. The Teaching of Computer Programming in Malaysia

Halili and Sulaiman (2019) in their research on the teaching of computer programming in rural schools in Malaysia reveal that the teaching of CP has the potential to end the digital lack in rural areas of Malaysia. However, factors like the shortage or non-existent technology facilities due to the high costs of ICT resources, skills deficiency, and inaccessibility of ICT resources, are critical issues rural schools face. In response to this, the Malaysian government has established National Broadband Initiatives (NBI) aimed at addressing the issue of inaccessibility of ICT resources in rural communities. Nonetheless, these interventions are at a low space. Their study (Halili & Sulaiman, 2019) further indicates that the challenges affecting the teaching of computer programming can be congregated as intermediary factors, which include gender, age, experience, and influential factors. Concerning influential factors, Silva et al (2020) concur that teachers' expertise in using technology (performance expectancy) is a determining factor. Whereas with the intermediary factor, Bose and Zaman. (2022) sustain that gender differences also play a vital role when it comes to the teaching of computer programming.

Tondeur, Aesaert, Prestridge, and Consuegra (2018), however, investigated the impact of age and gender on pre-service teachers' (student teachers) and their knowledge of computer programming and found the contrary. These student teachers were from 20 different institutions. The study revealed that there was no correlation between age and gender when it comes to the teaching of computer programming among rural communities' teachers. Instead, the study reported a positive impact on attitudes concerning teachers' competence. In addition, programming skills among pre-service teachers were reported low. This suggests that focus should be directed on strategies that can help skill teachers with acquiring the necessary programming skills at that level for them to effectively use it in their profession.

2.6.2 The Teaching of Computer Programming in Nigeria

Anyango and Suleman (2018) noted that discrepancies in resource allocation to remote areas impede the successful implementation of CP education in Nigeria. For example, Oyelere, Suhonen, and Sutinen (2016) and Knutas, Roy, Hynninen, Granato, Kasurinen, and Ikonen (2019) investigated the readiness and applicability of mobile learning to enhance computer programming education among Nigerian primary and secondary school students. The findings indicate that using mobile devices to learn CP is beneficial. However, the infrastructure needed to implement m-learning in rural locations is insufficient.

Suleman (2018) noted that there is generally poor performance of students in remote areas in Nigeria. This is largely due to inadequate resources. Similarly, Knutas et al (2019) found that there are many issues in Nigeria's current educational systems that limit the country's ability to implement the teaching of computer programming, including poor infrastructure, a lack of instructional materials, insufficient teacher professional development, and a lack of materials to support computer programming education. Suleman (2018) identify affordability and poverty, difficulties and poor infrastructure, political unrest and insecurity, and weak policy planning and implementation by the government as some of the challenges in the teaching of computer programming in rural communities in Nigeria.

Knuta et al (2019) investigated the challenges that computer programming instruction faces in Nigeria's rural settings and educational systems. Practical computer programming training was identified as a consistent method of delivering computer programming education to rural students in Nigeria. According to Udeani and Akhigbe (2020), recent ICT breakthroughs such as Intellimedia, NEPAD e-School, One Laptop Per Child (OLPC), and the Intel Classmate project are effective and encourage the distribution of digital resources to rural students. However, students in rural settings continue to underperform in computer programming as compared to their counterparts in urban cities.

According to recent research (Knuta et al., 2019), the few fortunate students in these rural locations can pass the topic (computer programming) despite the subpar conditions in which it is taught. A study by Mokeira et al. (2019) reveals that some of the teachers handling the subject lack proper training in the teaching of computer programming and are therefore unqualified to do so. However, it is most frequently used in these rural regions of the nation. Given these numerous problems, it is not surprising that there are several bottlenecks in computer programming instruction in these rural places.

2.6.3. The Teaching of Computer Programming in South Africa

In the South African context, Anyango and Suleman (2018) and Bers (2018) examined the teaching of computer programming among Cape Town secondary teachers. This study revealed that socio-economic factors are also barriers among certain schools. One of the schools in this study was a victim of socioeconomic factors. This school was situated in a hamlet affected by the high rate of crime and poverty, which had a direct impact on where the school is situated in the community. As a result, the school suffered from a lack of infrastructure due to theft. Teachers from such schools find themselves in a conceding position of working under challenging conditions. This concludes that the provision of computers and technical support are extrinsic barriers to the teacher, hitherto having a direct implication on the teaching of computer programming. Tripathi & Nasina (2017b) indicated that the uneven distribution of ICT resources and the lack of technical knowledge and support were highlighted as key barriers that affect the effective teaching of computer programming in most rural schools in the country. Evidence of this was reported in cases where some rural schools were operating under harsh conditions, like learning under trees. Their study (Al-emran & Shaalan, 2021). also found that in certain cases computers were available in schools, however, other factors were impeding the teaching of computer programming. These factors are classified as second-order barriers.

According to García-Peñalvo (2018), second-order barriers that affect the effective teaching of computer programming are intrinsic factors that are sometimes rooted in cultural dynamics.

Oyelere et al (2016) and Al-emran and Shaalan (2021) refer to these barriers as teacher-level barriers because they are factors that are directly related to the teacher. Therefore, understating these barriers means studying the attitudes and beliefs of teachers, as they are intrinsic factors that strongly affect teachers for their professional delivery. A study conducted on barriers by

Silva et al (2020) avers that the teaching of computer programming in Rwandan secondary schools is not different from that of Malaysia. Teachers lack programming skills, and this is a strong factor that influences their attitudes and beliefs in teaching computer programming. This is also supported by Cheah (2020). Al-emran & Shaalan, (2021) emphasizes the importance of equipping teachers with the necessary programming skills that can change their perceptions of the teaching of computer programming experiences in the classroom is paramount.

2.6.4 The Teaching of Computer Programming in Uganda

Siponen and Tsohou (2018) examine the teaching of computer programming in Uganda. The findings indicate that Uganda faces similar issues as developing countries do including economic uncertainties, unproperly developed ICT infrastructure, high data cost, and unreliable electricity supply are some of the challenges that plague the country. This suggests that the teaching of computer programming is not fully embraced in all schools, especially in rural schools. These critical barriers remain mostly in schools that are located in rural settings and the enhancement of the teaching of computer programming remains unsolved. These barriers are broken down into first-order and second-order barriers.

According to Avidov-ungar et al (2022), first-order barriers are obstacles that do not form part of teachers' profiles. These barriers are extrinsic and include the unavailability of resources as well as a lack of technical support. Buabeng, Ntow, and Otami, 2020) sustain that first-order barriers that include the school's location and environment as well as teacher readiness, teacher perceptions towards programming, and interpersonal factors, can be major barricades to the teaching of computer programming in rural schools. Some studies sustain that the biggest challenge affecting the teaching of computer programming on the African continent is unaffordability (Abdulai and Hickey, 2016; Siponen and Tsohou, 2018). Constraints such as the lack of ICT resources, skills deficiency, and poor infrastructure, are all centered around unaffordability due to high costs; this poses a great threat to the growth of the continent.

2.6.5 The Teaching of Computer Programming in Ghana

Ghana has recently established several schemes to offer rural communities equal access to technology. These interventions include one teacher - one laptop project, free Wi-Fi to selected SHSs, and one student - one laptop initiative, among others. However, the difficulties in Ghana's rural communities remain difficult to resolve (Yeboah et al., 2020; Yidana, 2015; Apeanti & Essel, 2021; Ussiph, 2018; Luu et al., 2019; Owusu-Ekuful, 2018). The Ghana Education Service (GES) and the Ministry of Education (MoE) added an elective Information and Communications Technology (ICT) course into the Senior High School (SHS) curriculum in 2008. The course was designed to provide students with the opportunity to "acquire knowledge and abilities to operate efficiently at a higher level of competence, allowing them to pursue further ICT courses at the tertiary level or enter the labor market" (Yidana, 2015; Apeanti & Essel, 2021; Ussiph, 2018). The course is divided into sections, each of which is further divided into units. Topics with fewer than two or three units are studied for a term. Introduction to computer programming, which is a core component of every information technology curriculum, is one of the sections that students at this SHS level must study.

Buabeng-Andoh (2015) assessed how ICT resources in Ghana empower the teaching of computer programming in Senior High schools. The findings revealed that ICT usage in schools remains persistently low due to insufficient knowledge and training among teachers. This study also pointed out that textbooks are the only teaching and learning tools for most schools since these schools have no access to ICT Laboratories. This, therefore, concludes that there is a big challenge for both teachers and students who find themselves in these remote areas.

A study was conducted by Luu et al (2019) to assess the feasibility of adding computer programming to the Basic level curriculum of the Ghanaian Education System. The findings revealed that Junior High School (JHS) students' have good knowledge of ICT and Mathematics, which are critical for acquiring effective computer programming skills. However, most of the sampled schools that had "RLG Laptops" were not functioning. Other logistics such as computer laboratories, projectors, printers, and textbooks were rarely found. Aside from the scarcity of these key logistics, the quality of the human resource (teachers) has impacted negatively the program implementation.

According to Yidana (2015) and Apeanti and Essel (2021), the percentage of literacy and internet penetration in rural areas is still less than one percent. As a result, the Ghanaian government is working to improve its ICT development strategy in rural areas through the National Communications Authority (NCA). Apeanti and Essel (2021)and Ussiph (2018) report that there are several challenges faced by rural communities when it comes to learning computer programming. These issues include organizational, technical, financial, and social. For organizational aspects, the factors identified were a lack of interest and expertise in the subject as well as the lack of interest by the private sector to participate in the development of ICT in rural areas. Based on the technical aspects, hardware shortages, lack of appropriate infrastructure, lack of software and telecommunications systems, and weak expertise are among some of the bottlenecks in rural areas. Financial challenges involve high costs for the purchase of hardware and software, high costs for internet access, the cost of hardware maintenance, the cost of upgrading the systems, and the lack of investors to invest in rural areas, from both the public and private sectors. Social factors include the aspect of rural 'technophobes' not wanting to use ICT resulting from rural communities not understanding the benefits and advantages.

Additionally, regulation support from the parties involved is insufficient, and old or inappropriate strategies hinder the development of robust ICT activities in rural areas. Furthermore, rural communities also have the lowest level of knowledge of using ICT, lack expertise in handling ICT equipment, and also have rigid thinking against the advantages of computer programming. All the above factors clearly show the challenges and problems faced by rural communities in the teaching of computer programming.

2.6.6 Chapter Summary

This chapter reviewed relevant literature regarding computer programming. By way of summary, the chapter provides an overview of computer programming and its definitions as well as the evolution of computer programming. Discussed in this chapter are also the theories and concepts that have been applied to the study of computer programming. Also presented in this chapter were gaps in researcher literature that could be explored by way of future research.

CHAPTER THREE

THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

3.1. Chapter Overview

This chapter discussed the theoretical basis for the hypothesis development. The Fit-Viability Theory by Tjan (2001) underpins the study and aided in the development of the conceptual framework for the study. The chapter is divided into seven sections. The introduction is in section one. The second section entails the theory used to underpin this research. The third and four sections captured the outlined hypotheses and the conceptual framework of the study, justification of the use of the theory for the study is captured in section five, followed by the limitations of the theory in section six, and lastly, a summary of the theories and hypothesis are contained in the seventh section.

3.2. Fit-Viability Theory

Tjan (2001), a consultant for SUN Microsystems at a time when online commerce was just starting to gain traction and managerial attention, developed the Fit-Viability Theory (FVT) to analyze internet ventures. Tjan (2001) study explained the relationship that existed between the quantitative viability the internet offers and its qualitative fit goals within the SUN Microsystems company. The Fit-Viability Theory, in its developmental stages, began as the Fit-Viability Model (FVM) with a framework to assess a business investment in its internet project. This became important because, businesses were investing in different internet projects and were not certain of the outcomes for them and their stakeholders (Tjan, 2001). Additionally, businesses were relying on obsolete and outmoded strategies, which could not explain the precariousness of internet technology and the vagueness of how the latest application would be received or used (Tjan, 2001).

The 'Fit' dimension of the model assesses the qualitative measures of the internet project and its alignment with the firm's goals, core values, capabilities, ease of implementing the technology, and other initiatives. The 'viability' dimensions of the model on the other hand, quantitatively assess the return on each investment as stated by the SUN Microsystem company (Tjan, 2001). Additionally, the researcher mentioned that initiatives that ranked excellently in both dimensions suggested there is a positive investment potential due to the extreme predictive value for success. However, the initiatives that ranked low in both dimensions depict negative investment potential. Furthermore, if the business firm's project possesses both a 'high viability' rating and a 'low fit' rating, this means that the business firm is ready for executing the project, but that the nature of the task does not fit the technology; hence it is not a good match (Larosiliere & Carter, 2016). Thus, the project is assigned to another business. Projects with a high fit rating but low viability are restructured to better their economic position before executing the project.

Furthermore, the Task Technology Fit (TTF) propounded by Goodhue (1995), and Goodhue and Thompson (1995) were adapted with the FVM by Tjan (2001) and Liang et al. (2007) to include the fit dimension to assess why a particular technology fits a task. The Fit-Viability Theory according to Tripathi and Nasina, (2017) is outstanding in assessing the acceptance, performance, and implementation of new technology when compared to the various TAM versions. In addition, Mohammed et al. (2017) added that the Fit-Viability Theory is suitable for investigating the degree to which the technology fit as well as the value of the technology concerning its application and performance, whiles maintaining the environmental factors. Furthermore, Tripathi and Nasina (2017) observed that the Fit-Viability Theory can be adopted in research studies that seek to investigate the technical as well as the organizational factors that influence the implementation and challenges of technology.

The FVT has been adopted in several studies such as (Larosiliere et al., 2016; Yoo & Kim, 2018), and has supported empirical studies that have examined the viability and task-technology fit of Information Technology (IT). Although the TTF has some similarities with the FVT, for instance, both theories assess the benefits businesses derive from ICT initiatives concerning their task requirements. Likewise, there are some significant differences between the TTF and FVT. The difference is that TTF employs user evaluations to compare the successfulness of the fit to the technology. Whiles, the FVT employs financial and usage outcomes to compare the acceptance level and success of the technology.

3.2.1. Task-Technology Fit Dimension of the Fit-Viability Theory

When a new technology is being adopted, the Fit, which is the degree to which the technology adopted equals the task characteristics of the work that needs to be done, produces a positive impact in achieving the individual's task (Goodhue & Thompson, 1995). The task-technology fit dimension evaluates which means the technology and the task requirements match (Larosiliere & Carter, 2016; Porumbescu, 2016). To explore the relationship between Task Technology Fit (TTF), viability, and performance of the teaching of computer programming in rural Ghana in an era where technology is widely used for business improvement and educational purposes, the research hypothesis must be firmly established in theory (Porumbescu, 2016; Larosiliere & Carter, 2016; Algarni, 2016).

The 'Task' refers to the relevance of the task to be implemented (Tripathi & Nasina, 2017). A major objective of successful delivery in the teaching of computer programming is to make the lessons practical and interactive, less difficult for students to comprehend, while boring tasks are made more appealing, easy, fun, and engaging. As a result, it is appropriate to look at the task "computer programming" as well as the delivery of the course in rural areas. Goodhue and Thompson (1995) opined that the task–technology fit is the interaction between task requirements; individual abilities; and the functionality of the technology. The authors further proposed that the construct (task technology fit) should be referred to as 'task–individual–technology fit' since according to them, exhibits the true nature of the construct (Goodhue & Thompson, 1995). Correspondingly, Liu et al. (2017) studied computer programming in information systems and proposed that the construct task technology fit should include the desired user system interactions (competition versus cooperation); the expected recurrence of system use; and the dual outcomes of the teaching and learning computer programming. The authors explained that there is a need to establish a fit between teaching and learning computer programming. That is the project fundamentals and all other characteristics. This assertion by the authors was informed by theoretical studies in information systems, psychology, economics, management, and marketing. These studies helped in unpacking diverse dimensions of fit and established explicit principles which can serve as a guide for future system projects, and research studies as well as presented descriptive questions that need further investigation.

On the relevant issues of task characteristics, Buabeng, Ntow, and Otami (2020).

describe a task with desirable results or what it does and behavioral necessities (how it is done). Liu et al. (2017) focused on computer programming and behavioral requirements alignment of targeted tasks and found out that, the relevant task characteristics issues about computer programming have not received many studies. Mohammed et al. (2016) on task characteristics on work design, confirmed that task characteristics lead to satisfaction on the job, work intrinsic motivation, as well as reduced turnover. Concerning the model of job characteristics; Ussiph, (2018) and Luu et al (2019), proposed five fundamental characteristics of a job or task to be; skill variety, task identity, task significance, autonomy, and feedback. These fundamental characteristics have been confirmed by Oyelere et al (2016) and Al-emran & Shaalan (2021), to be relevant issues of task characteristics. Liu et al. (2017) further point out that literature on intrinsic motivation has addressed task characteristics indirectly in extant literature.

Additionally, Bakar and Mukhtar (2019) observed that task offers varied challenges and uncertain outcomes that need to be studied. Buabeng, Ntow, and Otami (2020) reiterate the importance of a task being efficient. These authors added that when the task is efficient it establishes the task. Although, work design and intrinsic motivation literature have provided insights into task characteristics that can promote engagement and satisfaction. Liu et al. (2017) as well added further that only a few studies have explored how the teaching of introductory computer programming can assist task characteristics as well as the interaction between tasks and the seamless operations of the subject.

According to Chakraverty and Chakraborty (2020), Teaching and Learning programming is a multifaceted process that involves gaining knowledge of the syntax and semantics of a language as well as developing general problem-solving skills. Programming complements task characteristics and this makes the teacher effective (Mweshi & Sakyi, 2020). As noted by Siponen and Tsohou (2018), programming design elements and the task should work to ensure teachers and students master programming skills to satisfy the shortfalls in the task activity. Furthermore, the selected programming elements should be consistent to match the task activity. For instance, the element of the content-specific assignment should be consistent and suitable to measure the task activity such as the knowledge-sharing task activity (Liu, et al. 2017). Liu et al. (2017) added that programming has been prevalently used to improve the task. The importance of the task has been mentioned in previous studies such as a Fit Viability Case Analysis of Ghana by Abubakar (2019).

The TTF is a recognized concept that matches the features of technology to the requirement of the task. In other words, the capability of IT to support a task (Goodhue & Thompson, 1995). In the broad TTF framework, a task is defined as an action carried out by individuals to transform inputs into outputs and thereby satisfy their information demands. Task characteristics are those that a user might carry out using IT. TTF theory states that IT is more likely to have a beneficial impact on individual performance if its features match the organizational task requirements.

Technology characteristics of fit are referred to as the Information Communication Technology required to implement a given task. To satisfy the objective of Fit the task as well as the technical characteristics should be achieved (Mohammed et al., 2016; Ab Hamid et al., 2017; Agyapong & Ojo, 2018; Al-emran & Shaalan, 2021) Concerning the teaching of computer programming, it is a requirement to establish the alignment between the target area, that is the rural areas (Liu et al. 2017; Park et al., 2019; Cechella et al., 2021). Technology Characteristics assess technological factors that influence the teacher's delivery and adoption of the technology.

Studies (Mohammed et al., 2017; Yoo & Kim, 2019) have suggested these technology characteristics factors are relative advantage; compatibility; complexity; trialability, and security. Although the teaching of computer programming is appealing to many, without the right technology structure in the target areas, computer programming will be unfeasible. Hence, CP can have a significant impact on remote areas (Larosiliere & Carter, 2016; Liu et al., 2017).

3.2.2. Viability Dimension

Viability investigates factors that influence Information Technology adoption within an organization (Liang et al., 2014; Liang et al., 2021; Mohammed et al., 2017; Yoo & Kim, 2019). With regards to the FVT, the factors are Economic Reasons; IT Infrastructure Availability, and Organizational Factors. Yoo and Kim (2019) confirm the effectiveness of economics, IT infrastructure, and Organizational factors in determining the viability of a new Information Technology. Similarly, Bankuoru Egala and Afful-Dadzie, 2022 and Turban et al. (2011) in a study to determine the adoption of social networking software for group decision making concluded that the viability constructs of the FVT are effective in assessing how viable an IT system of the hypothesis that such factors (economic, IT infrastructure, organization) affect Viability. Accordingly, Yoo and Kim (2019), define Viability as the degree to which the selected system, influences the organizational political, social, economic, environmental, and technological infrastructure. Empirical studies have been conducted on various adoption of IT in different sectors (Larosiliere & Carter, 2016; Yoo & Kim, 2019) have increased and improved the reliability of the economic, IT infrastructure, and organizational factors are appropriate issues that affect the viability of IT system.

The economic reasons assess the economic conditions of the institutions or persons, as this can influence the type and degree of investment made toward IT developments (Chandra & Kumar, 2018). Furthermore, Pollak et al (2019) and Silva et al (2020) mentioned that the financial strength of an organization determines its information technology adoption and further added that the strong financial well-being of an institution affords them to invest in IT system upgrades. Hence, it can be deduced from the other studies that the economic well-being of a school can influence the IT system they adopt and use for their organization's operations and the amount of investment they are willing to make for current and future IT infrastructure.

3.3. Justification for the Choice of Theory for the Study

Many theories have been employed in IS research to investigate the adoption and implementation of information technologies within institutions (Ab Hamid et al., 2017; Agyapong & Ojo, 2018; Al-emran & Shaalan, 2021). Some of these theories include the Task-Technology Framework (TTF) by Avidov-ungar et al (2022), the Fit-Viability Model (FVM) by Owusu and Nettey (2022), the Technology Acceptance Model (TAM) by Bakar and Mukhtar (2019), the Diffusion of Innovations (DOI) by Bers (2018), and the Theory of Acceptance and Use of Technology (UTAUT) by Bose and Zaman (2022). Several adoption-related fields, such as e-learning and e-commerce, e-counseling, healthcare, business intelligence, and tourism, have found great use for these theories (Bers. 2018; Becker & Quille, 2019; Berssanette, 2021; Bose & Zaman. 2022).

Another theory called the Theory of Reasoned Action (TRA) has been used extensively in IS research to explain the relationship between motivation and gamification implementation (Cheah, 2020; Davenport, 2018). Arguably, few studies have applied IS theories to explore the teaching of CP. Studies on the topic have largely relied on machine learning, logistic regression, and predictive models without any underlying theories to predict how CP will be taught (Ussiph, 2018; Yoo & Kim, 2018; Yoo & Kim, 2019 Fang et al., 2022).

Furthermore, Watson (2014) and Wickramasinghe (2018) used the Descriptive Survey Model to conduct a general analysis of countries that have integrated computer programming education into their curricula and a content analysis of studies on the teaching of CP in Turkey. Bakar and Mukhtar (2019), on the other hand, used attribution theory to investigate stakeholders' satisfaction with the teaching of CP. Avidov-ungar et al (2022), discussed the various concepts, opinions, journals, and others, on the subject and reflect on the relevant policies that support the teaching of CP in rural areas and how it is helping shape the technological facets of the Ghanaian educational system and the economy as a whole. However, Halili and Sulaiman (2019), used a data mining approach to predict students' performance. Silva et al (2020), also used a machine learning approach to collect historical data of previous year's students from an institution and investigated students from underdeveloped areas that have a weak foundation for solving math and physics problems, making learning programming difficult even in university settings. Therefore, it is important to consider a theoretical model such as FVT to determine how the task, technology, and environment fit the requirement of the teaching of CP in rural areas at the SHSs level in a developing economy. The viability of the organization's finances, infrastructure, and economy must also need to be examined.

3.3.1. Limitations of the Fit-Viability Theory

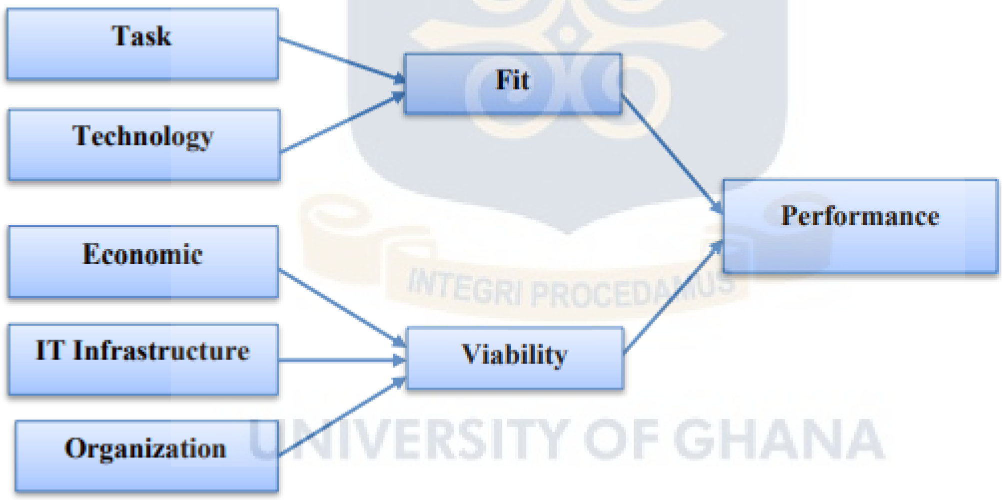
Although the FVT has been acknowledged as being essential for the study of factors influencing the performance of innovations and information systems (Liang et al., 2007), it has some drawbacks. Studies that evaluate performance often face theoretical and methodological issues (Luxton-reilly et al., 2019). For example, the current study identified the FVT's shortcomings in the literature review, such as the theory's inability to explain the steps involved in the multi-stakeholder approach to project identification and need assessment (Hatta et al., 2013; Larosiliere et al., 2016). According to García-Peñalvo (2018), FVT has neglected the role of civil society and inter-agency interactions, particularly the public institutions as key actors at various levels. Recent studies have viewed the FVT as a temporary tool for determining whether an organization is ready to implement new projects or technologies (Podojil & Cudlín, 1989; Pollak et al., 2019; Silva et al., 2020).

The theory is also criticized for being overly simplistic for complex social phenomena. For instance, the same environmental pressures of organizations may respond to the issues differently, as demonstrated by Shute et al (2017) analysis. As a consequence, the suggested claims of the fit dimensions of an organization as posited by the FVT may not be accurate.

Additionally, the FVT disregards the organizational actors who are crucial to a project's implementation. For instance, in the case of teaching computer programming in rural areas, the instructors do not match the criteria for the FVT's fit or viability components (Suleman, 2018; Tokarz & Malinowska, 2019).

Despite these drawbacks, the FVT is used in this study because IS researchers must assess how successfully projects like teaching CP in rural areas are implemented (Park et al., 2017; Munson & Zitovsky, 2018; Nelson & Ko, 2018). The FVT is also useful for clarifying how the fit dimension assesses how well a technology feature complies with the task's requirements. Viability, on the other hand, evaluates how prepared the organization's infrastructure is to carry out the project, placing special emphasis on the project's overall economic viability, technical infrastructure, social and government preparedness, and the implementing agency, such as the GES.

Figure 3. 1 Fit-Viability Theory



Source: Liang et al. (2007)

3.4. Hypotheses Development

3.4.1. Task-Technology Fit Dimension on Computer Programming

The task-technology fit dimension assesses how well technology matches the task requirements of an entity or organization (Larosiliere & Carter, 2016). Previous Studies (Liang et al., 2007; Apeanti & Essel, 2021; Ussiph, 2018; Luu et al., 2019) have demonstrated that the fit between the characteristics of task and technology can lead to increased performance or utilization. According to Goodhue and Thompson (1995) proponents of the Task Technology Theory, when it comes to the adoption of new technology by individuals or organizations, the Fit, which is defined as the degree to which the characteristics of the tasks that the user must perform meets with those of the technology to be adopted.

3.4.2. Task-Fit and Computer Programming Dimension

Tasks are broadly defined as the relevant task that needs to be carried out (Liang et al., 2007). In terms of implementing computer programming education in rural Ghana, the task is to study the facilities (ICT tools and ICT laboratories). Therefore, the task characteristics of interest in this study include those that might require the teacher to depend heavily on Information Technology (the internet, programming Apps, projectors, etc.) for teaching and learning in rural areas. Extant studies that employed the Fit-Viability Theory (Babah et al., 2020a; Owusu & Nettey, 2022; Mohammed et al., 2016; Yoo & Kim, 2019) concluded that when the task requirement coincides with the chosen information technology, results in higher performance. Extant studies in IS (Tripathi & Jigeesh, 2015; Mohammed, et al., 2016; Larosiliere & Carter, 2016; Yoo & Kim, 2019) have made use of the FVT in various contexts. Tripathi and Jigeesh

(2015) and Owusu & Nettey (2022) observed that automation, resource sharing, multitenancy, internal expertise, and remote implementation as the task characteristics related to cloud computing adoption and usage. Furthermore, Yoo and Kim, (2019) confirmed task characteristics have a positive influence on Fit, which had a positive influence on usage. This study, however, postulates that task characteristics significantly influence the teaching of computer programming in rural areas. Hence, this hypothesis is formulated based on the aforementioned augmentations:

H1: *Task characteristics of teaching computer programming have a positive influence on lesson delivery in rural Ghana Senior High Schools.*

3.4.3. Technology- Fit and Computer Programming Dimension

To get the most out of technology, an institution should be able to establish some degree of convergence of technology characteristics (Babah et al., 2020a; Owusu & Nettey, 2022). In the case of computer programming education, the fit dimension of technology is about teaching and learning tools/technologies (Owusu & Nettey, 2022). This assertion is supported by literature regarding the technology fit characteristics that lead to an increase in performance in the implementation of a project (Apeanti & Essel, 2021; Ussiph, 2018; Luu et al., 2019). Mohammed et al (2016) developed a model to investigate the factors that influence cloud computing adoption as part of developing countries' alternatives to implementing e-government services employing the Fit-Viability theory. The study found that the technical characteristics that influence cloud computing adoption are Relative Advantage, Compatibility, Complexity, Trialability, and Security. Similarly, Larosiliere and Carter (2016) in their study to investigate electronic government maturity and its determinants, used the Fit-Viability Framework to assess e-Government Maturity in different countries. The author's research findings demonstrated higher levels of positivity between fit and the technology which further leads to a positive impact on the overall usage of the system. Accordingly, in this study, technology can positively influence the teaching of computer programming in rural areas. Hence, the hypothesis below is postulated for investigation in this study:

H2: *Technology characteristics significantly influence the teaching and learning of computer programming in rural Ghana Senior High Schools.*

3.4.4. Economic Viability Dimension on Computer Programming

The economic viability dimension refers to the schools (rural areas) available resources that influence the teaching of computer programming and the impact on the project performance (Larosiliere & Carter, 2016; Liang et al., 2014). Thus, the economic strength of the schools is comprised of the growth and productivity factor, which shows the schools' capacity to afford financial support for the teaching of CP in rural settings. A strong economy will benefit the schools by providing enough funds for the expansion and modernization of teaching and learning, value creation, economic steadiness, and prosperity of users of the technology in the country (Owusu & Nettey, 2022). Furthermore, economic viability assesses the budgetary or financial allocation to state institutions for the adoption of new technologies, like computer programming, which may have an impact on performance (Bag et al., 2020). According to earlier studies by Brierley (2017) and Gamlen and McIntyre (2018) adequate budgetary allocation or funding can favorably impact performance in state-run institutions like the Ghana Education Service (GES) on both a direct and indirect basis. According to Mohamed et al. (2016) economic viability measures the degree to which the economic benefits of an adopted technology are greater than the economic costs, either, it determines whether a particular technology/application is cost-effective. Tripathi and Nasina (2017) study, found that economic stability, as well as economic prosperity, significantly impacts Information Communication Technology (ICT) adoption and usage. The assertion by Tripathi and Nasina, (2017) is consistent with the findings by Larosiliere and Carter (2016). Larosiliere and Carter (2016) study demonstrated that economic viability is statistically significant in determining the viability of adopting and usage of new technology by an institution. Concerning this study, it is presumed that the economic well-being of the teaching of computer programming in rural schools, influences its adoption and usage of IT operations. For instance, an organization that is economically stable and has enough or excess funds can invest in information technology or contemporary digitalization equipment. Hence, this study postulates that the economic well-being of rural schools (institutions) is a viable influencer in the adoption and implantation of computer programming. The third hypothesis states that;

H3: *Economic well-being has a positive influence on computer programming teachers' performance in rural Ghana Senior High Schools.*

3.4.5. IT Infrastructure Viability in Computer Programming

According to Liang et al. (2007), IT infrastructure comprises IT platforms and information services required for supporting the teaching of CP. Liang et al. (2007) added further that IT infrastructure provides the foundation that supports technological operations and augments development within the organization. Thus, the schools' computing, information management, and communication platforms, along with the shared IT services, standard applications, and human IT infrastructure, are all a part of the IT infrastructure. The IT infrastructure facilitates business growth and provides essential operational technological support (Liang et al., 2007). Additionally, if the MoE and the GES receive adequate funding and additional resources, computer programming instruction in rural areas will be more effective. These funds will be used to buy new equipment, improve the facilities that support computer programming education, and carry out other related tasks (Umapathy & Ritzhaupt, 2017; Uzunboylu et al., 2017). Empirical researchers, that have used the FVT, have observed how viable IT infrastructure impacts performance. Some of the studies include (Podojil & Cudlín, 1989; Tondeur et al., 2018; Tripathi & Nasina, 2017). Mohamed et al. (2016) for instance, studied the IT infrastructure viability on technology adoption decisions by assessing the readiness concerning IT infrastructure. The results demonstrated that IT infrastructure is a viable measure in determining the usage of new technology within an organization. Thus, this study presumes that IT infrastructure when available and accessible can significantly influence the adoption and usage of new technology since its availability encourages many to use the new technology. This study thus postulates that when there is the existence of basic IT infrastructure, it influences stakeholders to improve upon the already existing IT infrastructure with time. Hence, the hypothesis:

H4: *Information Technology infrastructure significantly influences the performance of computer programming teachers in rural Ghana Senior High Schools.*

3.4.6. Organization Viability in Computer Programming

Organizational viability is defined as the readiness of the organizational resources that supports the adoption of new information technology (Park et al., 2017). In other words, the organizational factor accesses the total readiness of the school (s) to implement the teaching of CP in rural settings. The organizational factor is considered a key feature to ensure the sustainability of the initiative. Thus, the structure and the organizational maturity of the implementing agency must also be assessed. This study operationalizes the organizational construct to evaluate the readiness of the school (s) to utilize the CP functions and their features.

Further, an institution's readiness in terms of finances, structure, and technology can influence whether it succeeds or fails. Furthermore, Mohamed et al. (2016) mentioned that organizational viability is the supposed organization's ability to adopt a new technology or implement a new system is influenced by a set of structural factors. This context can be explained by the resources of the firm which include, connections between employees, intra-firm communication processes, firm size as well as resources (Mohamed et al., 2016). Ullah et al (2020) mentioned that support from senior management and the level of knowledge in IT of members of the organization are factors that influence organizational IT adoption. Subsequently, Liang and Wei, (2004) studied the adoption of mobile technology in business organizations; however, during the period of their study, there were few studies on how organizations decide on adopting new (mobile) technologies and which factors determine the success or failure of adopting this new technology. Nevertheless, Liang et al. (2007) identified the factors to be business processing reengineering, user competence, and top management support as fundamental influencers for organizational viability to adopt new technology. The authors further validated the FVT by stating that the viability of an organization can aid in determining whether information technology is feasible in performing the required objective. Thus, this study presumes that the organization plays a major role in ensuring the success of the adopted technology through the management and competencies of all members of the organization.

Concerning this study, the success of teaching computer programming in rural Ghana depends on top management support (that is the specific educational unit). The study postulate that:

H5: *The support of the top management (school/organizational support) has a positive influence on the performance of teachers teaching computer programming in rural Ghana Senior High Schools.*

3.4.7. Motivation Viability Dimension

The concept of motivation is described by Tondeur et al (2018) as the "psychological processes that cause the arousal, direction, and persistence of behavior". Although motivation has received widespread attention in the literature (Podojil & Cudlín, 1989; Tokarz & Malinowska, 2019; Ganta, 2014; Nikula et al., 2011), this thesis limits the term motivation in the context of teachers who teach computer programming in rural Ghana. According to Abdulai and Hickey (2016), motivation is 'how to provide something to a person to drive him/her to do something. In the two-factor theory, motivation is the variable most strongly correlated with job satisfaction. Herzberg and his colleagues argued that to increase employees' job satisfaction the motivation factors must be improved.

The motivators, as Herzberg's theory called them, are inherent to the profession and might result in favorable attitudes toward it because they gratify the "desire for progress or self-actualization" (Armstrong & Sambamurthy, 1999). Motivation factors are related to a person's job satisfaction and include advancement, the work itself, the possibility of growth, responsibility, recognition, and achievement (Atmatzidou & Demetriadis, 2016). Unmotivated workers (programming teachers) are more likely to put in little to no effort at work, which will lead to bad performance. They will also avoid going to work as much as possible, leave school if given the chance, and create subpar work. Teachers who are motivated to work, on the other hand, are more likely to be consistent, creative, and productive, producing high-quality performance (Akinola & Nosiru, 2014).

Most employees need the motivation to feel good about their jobs and perform optimally. Some employees are money motivated while others find recognition and rewards personally motivating. Motivation levels within the workplace have a direct impact on employee productivity. Workers who are motivated and excited about their jobs carry out their responsibilities to the best of their ability and productivity increases as a result. Hence, this study postulate that:

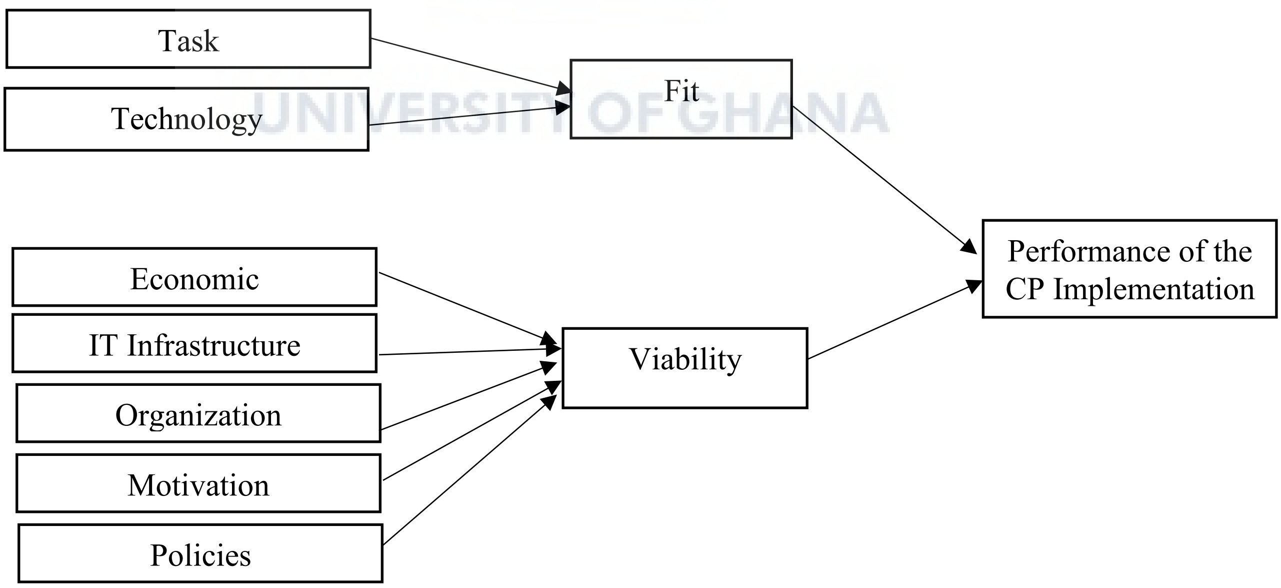
H6: *Teacher motivation significantly improves the performance of teachers teaching computer programming in rural Ghana Senior High Schools.*

3.4.8. Ghana Education Policy Viability Dimension

Ghana is one of the nations with the highest rates of educational investment in the world, investing more than 11% of its GDP and more than 30% of its government budget (Abdulai & Hickey, 2016; Abukari et al., 2015; Buabeng et al., 2020). However, given the widespread sectoral and geographical inequities, state policies generally do not favor the rural areas in the northern part of Ghana. For instance, just over 30% of individuals in the five regions of the north (Northern, Upper East, Upper West, Savanah, and North-East) have previously attended school, compared to more than two-thirds of adults in nearly all of the southern regions (Abukari et al., 2015). According to a recent UNESCO assessment, the North of Ghana, where more than 60% of the population lives in educational poverty, is the region with the worst educational conditions (defined as having less than four years of education) (Buabeng et al., 2020). Although many factors affect educational attainment, what matters is how much the government has done to address these disparities, particularly in terms of budgetary allocation to these areas to teach computer programming and ICT to close the gap in the state's urban areas (Abdulai & Hickey, 2016; Buabeng et al., 2020). By adding the policy element to the viability dimension in this study, the FVT framework was modified. The FVT constructs from Liang et al. (2007) are specifically expanded in this study to include policies. This is because, when the right policies are made in relation with rural areas environmental factors in the viability dimension it can influence the implementation of the teaching of CP and generally improves performance. The model is therefore conceptualized in a way that facilitates the assessment of the teaching of CP in rural settings. The adapted theory used in this study is primarily based on the fit viability model developed by Tjan (2001), which builds on the fit viability theory developed by Liang et al. (2007) and the refined Fit-Viability Conceptual Framework by Owusu and Nettey (2022). The model of the IT-Business alignment dimensions developed by Ofosu et al. (2021) also served as a guide in developing the adapted theory for this study. Hence, this study postulates that:

H7: *Education policies significantly influence the performance of teachers teaching computer programming in rural Ghana Senior High Schools.*

Figure 3. 2 Conceptual Model



***Source**: Authors' Construction*

3.5.1. Fit-Viability Framework

Based on the four areas in the matrix illustrated in Figure 3.3, an institution can easily estimate the best plan for implementing a project or technology. There are four things to consider: identifying a good target, discovering other technology, revamping the organization, or outright ignoring it (see Fig. 3.3). When applications are considered to have high viable counts but only a minimal count for fit, it shows that the organization is ready, but the task does not fit with the nature of the project's implementation (computer programming) or the technology (Liang & Wei, 2004a; Liang et al., 2007). As a result, rather than jumping on board for implementation (computer programming), it is preferable to seek more acceptable solutions for the task. An institution with a good fit but a low viability rating, on the other hand, would need to evaluate whether redesigning the organization could improve its success prospects before proceeding with implementation. Only projects (computer programming) with a strong task-technology fit (TTF) and organizational viability are deemed suitable options for financing and implementation. By utilizing the Tjan strategic matrix, Liang and Wei (2014) advanced the fit-viability framework, which combines the theory of task-technology fit (TTF) with the general idea of the organizational impact of information technology. The optimal time to adopt technology is therefore when it receives high marks for both fit and viability.

Figure 3. 3 Fit-Viability Framework

Viability		Fit: Low	Fit: High
	High	Find Alternative Technology	Good Target
	Low	Forget it	Organisational Restructuring

Source: (Liang & Wei, 2004a)

3.6. Characteristics and performance of CP implementation in rural Ghana

Drawing on earlier literature on the theory's applications in research, the current study applies the fit-viability theory to the teaching of computer programming in rural Ghana, as well as to the benefits and enhancement of student achievement in those schools situated in the country's remote regions. This study contends that the introduction of computer programming lessons in rural Ghanaian schools requires careful planning for teaching and learning, qualified human resources, and the right policies. This improves the technology's performance when the right measures are put in place by the Ministry of Education and the Ghana Education Service supervision, which results in excellent results.

3.7. Chapter Summary

In this chapter, the theoretical basis for the hypothesis development was reviewed. The developed hypotheses are in line with the reviewed theory and research objectives. Additionally, the chapter established the study's conceptual framework and extended the study's hypotheses. The FVT conceptual framework was adapted and extended to include teacher motivation tolls and educational policy. Based on the study's aims and research questions, hypotheses were constructed to address the research questions while also meeting the study's objectives. Following the development of the study's hypotheses, the following chapter outlines the methods and research design used to examine the hypotheses.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1. Chapter Overview

This chapter presents the research methodology used in the study. It discusses the research design, research approach, study population, sampling technique, methods of data collection, ethical considerations, validity and reliability, how the collected data was analyzed, and a chapter summary.

4.2. Research Paradigm

Researchers refer to a paradigm as their worldview, the framework for their study, and the framework through which they interpret their environment, their interactions with it, and their worldview (Armstrong & Sambamurthy, 1999; Atmatzidou & Demetriadis, 2016). According to Abdulai and Hickey (2016), a research paradigm is a way of developing a worldview that is based on philosophical presumptions about the nature of social reality. Thus, paradigms are essential philosophical frameworks that help researchers uncover multiple viewpoints on reality, knowledge, beliefs, and methods concerning a study (Buabeng, Ntow, & Otami, 2020). Epistemology, Ontology, and Methodology are the three main philosophical taxonomies that can be used to categorize paradigms (Bers. 2018; Becker & Quille, 2019; Berssanette, 2021; Bose & Zaman, 2022). Epistemology provides a philosophical foundation that aids the researcher in identifying true and appropriate knowledge (Leonard et al., 2018). What connection does the knower have to what is known? How do we know what we know? what is defined as knowledge? These are the questions epistemology seeks answers for (Boateng, 2016).

According to Lee et al (2017) explanation of ontology, there are various authentic social constructions of what reality is, both subjective and objective. Similar to how ontology includes the philosophy of realism and how reality is seen, whether it be an internal idea of the mind or an external construct (Creswell & Tashakkori, 2007; Boateng, 2016; Hatta et al., 2013; Larosiliere et al., 2016). Additionally, the methodology is concerned with the procedures utilized to learn about a phenomenon's actuality (Luxton-reilly et al., 2019) these procedures can include mixed techniques, qualitative research, and quantitative analysis. These three paradigm-related philosophies (epistemology, ontology, and methodology) aid the researcher in identifying the presumptions and events they are researching, as well as how to examine, delve into, and comprehend the research problem and the approaches taken to answer the research questions (Creswell & Tashakkori, 2007).

There are various paradigms, just as there are various classifications that distinguish them. The critical paradigms, interpretative paradigms, and positivist paradigms are the most popular and widely utilized paradigms that reflect key theoretical directions in IS (Creswell & Tashakkori, 2007; Boateng, 2016). These three odd paradigms each have a unique perspective on a subject and determine how social phenomena should be investigated (Boateng, 2016).

Choice of Positivism

The positivist paradigm is used in this thesis to further its stated objectives. According to Brierley (2017), positivists believe that it is feasible for researchers to gain objective knowledge of reality and the existence of a reality that is beyond human cognition. According to Gamlen and McIntyre (2018), positivism is the attempt by a researcher to link certain aspects of reality with how those parts are handled using a single independent variable.

In addition, the study uses the Partial Least Squares-Structural Equation Modeling (PLS-SEM) to analyze the data and assess how fit and viable computer programming education is in rural Ghana based on the hypotheses. Brierley (2017) and Gamlen and McIntyre (2018), contend that positivism enables the researcher to logically identify and explain real events. Additionally, Brierley (2017) emphasized that in positivism, the criterion for judging the veracity of a scientific theory is met when theoretically based predictions are consistent with data collected using one's senses.

The positivist paradigm has been and is still being used extensively by IS researchers. Brierley (2017) noted that there is still a large predominance of positivist research papers in the IS literature today. Similarly to this, many academics believe that positivist research dominates 81% of empirical IS research that has been published.

The positivist paradigm was employed for this study since it suggests using systematic measuring criteria to come to objective results. The paradigm is important for this study because, as noted by Brierley (2017) and Gamlen and McIntyre (2018), it offers the right strategy for conveying grounded knowledge through quantification and objectivity. The earlier theories suggested that objectivity implied a difference between the phenomenon being examined and the researcher. The experiment and observations are completely understood using the positivist paradigm as well. Gaining objective scientific knowledge for the investigation is made possible by positive thinking. In light of this, it is believed that the positivist paradigm is appropriate for this research endeavor.

4.3. Research Methods

Research design can be defined as "the entire plan for gathering data to answer the research objectives" (Brierley, 2017; Gamlen and McIntyre, 2018). Research methodology, according to Kalu (2017), is the systematic and theoretical evaluation of the techniques employed in a field of study to acquire data to understand a phenomenon. As a result, the research design is a thorough plan that specifies where and when to gather data as well as how to do it. According to Sovacool et al (2018), social scientists use two primary categories of research methodology. They use either qualitative or quantitative techniques. Creswell and Tashakkori (2007) did include a mixed method as a third methodology.

The quantitative technique, which is used to provide answers to queries involving measured variables, is mostly associated with the positivist paradigm. With this strategy, statistical analysis can be used to forecast and explain a phenomenon. The quantitative approach also involves measuring numerical data, testing hypotheses to support or refute a claim, and generalizing facts to explain how a phenomenon's cause and effect are related.

Furthermore, Siponen and Klaavuniemi (2021) continued by stating that the survey method uses data to explain the attitudes and opinions of a population that is studied and observed by taking a sample of the entire population. The researcher can therefore extrapolate from the results of the researched group and make projections for the entire population. Reasons for choosing a quantitative strategy include the fact that, in contrast to the qualitative and mixed method approach, the quantitative technique fits the study in context and aids in the extraction of incontrovertible evidence rather than only supplying information.

In this thesis, the researcher would apply the deductive approach to the examination of the hypotheses that have been generated. Data would be gathered by using a questionnaire for the study on computer programming teachers in northern Ghana. The quantitative research approach would be applied in this investigation. Numerals are seen as expressing the values and levels of many theoretical constructions and notions according to the quantitative approach, and the interpretation of these numbers is considered to be significant scientific evidence as to how a phenomenon operates.

4.3.1. Questionnaire Development

As already noted, this thesis uses a quantitative methodology. To gather pertinent information from ICT instructors in northern Ghana who teach computer programming, questionnaires were given to responders. Siponen and Tsohou (2018) criteria for data collection were adhered to during the construction of the questionnaire to guarantee the validity and reliability of the data-collecting instrument.

The literature on the instruction of computer programming in multiple areas was used to help build the study's questionnaire. The questions for each item were created based on the underlying theory, the Fit Viability theory. A pilot test was conducted to validate the instrument once the questionnaire's development was successful. Before the questionnaire underwent a preliminary test, the views and opinions of specialists in the quantitative research approach were asked. The preliminary test's helpful comments helped to enhance the questionnaire's substance. This was carried out to ensure the validity of the survey's information.

The questionnaire's content validity is evaluated along with its capacity to explain the numerous constructs for which answers are being sought. This was accomplished by carefully analyzing the justifications, wording, uniformity of the questionnaire, and general feel and appearance of the survey. The compliment helped improve the questionnaire. This procedure made it possible to improve the questionnaire to guarantee its dependability, accuracy, and content validity. Thirty (30) respondents participated in the validation test. The validation test's results were favorable. As a result, it illustrates the content's high degree of veracity.

4.3.2. Survey Questionnaire Design

The conceptual framework for the study and the hypotheses were used to design the questionnaire, which was used to gather information for the study's research questions. The questionnaire was divided into three sections. The first section was concerned with gathering information about the respondents' gender, age, and educational attainment. The second section focused on motivation and policy issues. The third and final section of the survey asked respondents a series of questions based on the theory's construct using a five-point Likert-type scale, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly

Agree. The Likert-type scale has been demonstrated to produce results that are accurate and consistent with multivariate analysis (Akinola & Nosiru, 2014; Alajmi et al., 2017).

Table 4. 1 Constructs and the number of questions used in this study

Constructs	No. of Items	Adapted From
Task-Fit	6	Akinola and Nosiru (2014), Yoo and Kim (2018)
Technology-Fit	5	Tripathi and Nasina (2017), Alajmi et al. (2017)
Economic- Viability	7	Akinola and Nosiru (2014) Larosiliere & Carter (2016)
IT Infrastructure- Viability	6	Yoo & Kim (2019), Wickramasinghe (2018)
Organization- Viability	7	Mohammed et al. (2016), Akinola and Nosiru (2014)
Motivation	7	Liang et al. (2021), Nikula et al. (2011), Tokarz and Malinowska (2019)
Policy	6	Al-emran and Shaalan (2021), OECD (2019)
Performance	5	Al-emran and Shaalan (2021), Goodhue (1998)

Source: Author's construction

4.3.3. Participating Settings

The population of the study consists of ICT teachers in rural northern Ghana who are into the teaching of computer programming. The choice of the population is for the simple reason that the five regions of the north of Ghana are typically rural, under-resourced, and less privileged; making the setting ideal for the study of the fit, viability, and performance of the implementation of computer programming particularly in rural Ghana (Agyapong & Ojo, 2018).

4.4.4. Sampling Technique and Sample Size

When conducting a research study, a sample is a subset of the entire population that the researcher employs to represent the entire population (Mweshi & Sakyi, 2020). Utilizing sampling, the researcher can conclude and make predictions about the general population by revealing concealed data about the population being studied (Rahi, 2017; Mweshi & Sakyi, 2020). Mweshi and Sakyi (2020) define a good study sample as one whose findings are comparable to those of the entire population using the same techniques for data collection and analysis. Therefore, to ensure consistency and reliability of the results, the researcher must carefully evaluate the size of the sample being used in the study (Ab Hamid et al., 2017; Agyapong & Ojo, 2018; Al-emran & Shaalan, 2021).

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Additionally, the data collection process also included the random sample method. Finding the sample size is essential for assessing how well data represents the population as a whole. More samples typically equal more accuracy (Kock & Hadaya, 2018). To estimate the sample for the study, the simple random sampling process is initially used. A population subset picked at random is known as a simple random sample (Rahi, 2017; Mweshi & Sakyi, 2020). With this sampling strategy, each member of the population has the same chance of being chosen. For the simple reason that it eliminates bias, random sampling is typically the method of choice for researchers. Due to their characteristic dispersion and lack of foundation, teachers who teach computer programming in rural SHSs in the five regions of the north of Ghana are a good fit for this study.

In the bid to determine the sample size necessary to estimate the proportion of teachers in northern Ghana that identify as teachers of computer programming with 95% confidence, a population proportion of 0.5, and a margin of error of 5%:

Furthermore, it was found that PLS-SEM principles contributed to establishing sample adequacy. The rule of 10-times, which specify the least sample size that can be used for any study in PLS-SEM (Brierley 2017; Gamlen & McIntyre, 2018; Rahi, 2017; Mweshi & Sakyi, 2020). The rule stipulates that the respondents (sample size) representing the population in a study should be six times more than the construct with the highest set of questions (Gamlen & McIntyre, 2018). From the research framework, the constructs with the highest number of indicators were Economic, Organizational, and motivation with seven (7) indicators. Thus, the least sample size for this study per the “10-times rule” can be computed as 7*10=70. Hence, a minimum of sixty (60) responses is needed for the study of seven (70) responses. However, the study obtained a total of one hundred and fifty (150) respondents which by far exceeds the least sample size prescribed by the “10-times” rule. Additionally, it is difficult to give the questionnaire to all of the programming teachers in the five northern regions including Upper East, Upper West, North East, Northern, and Savana due to the sheer number of respondents across the northern part of Ghana.

4.3.5. Data Collection Instruments

Data collection is the process of gathering data and relevant information that is necessary to respond to the study questions (Siponen & Tsohou, 2018; Brierley 2017). Data collection sources can be classified into primary and secondary data collection sources (Boateng, 2016).

The author further explained that secondary sources depend largely on documentation, archival records, and physical artifacts (Boateng, 2016).

This study used only primary data sources. The data was gathered in three (3) steps. This was done by designing a survey instrument, selecting a frame for sampling as well as apportioning questionnaires to respondents. Questionnaires were used in gathering data. The developed hypotheses of the study were converted to design the questionnaire. This process was carried out to guarantee the questionnaire is asking the right questions to respond to the research questions. The response was gathered from ICT teachers in northern Ghana who are into the teaching of computer programming.

The questionnaire was administered using a standardized close-ended questionnaire. This method of gathering information was chosen because it allows respondents to work on their schedules and also because it allows respondents to feel comfortable answering questions that are personal and that would have been difficult to obtain through traditional face-to-face interviews. The closed-ended questionnaire assists in reducing the influence of the researcher as well as directing the conversation in a specific direction.

Furthermore, google forms were sent to respondents who were comfortable using either their phones, tablets, or laptops to answer the questions. Data from respondents was gathered from August to September 2022. One hundred and fifty (150) responses were received from google forms.

4.4. Method of Data Analysis

Immediately after obtaining the survey respondents' responses. The following stage of the study involves organizing, summarizing, and analyzing the collected data to draw conclusions. Data analysis, according to (Berssanette, 2021; Bose & Zaman. 2022), entails searching through the data to weed out irrelevant information as well as modifying and re-modeling the collected data to communicate crucial information that helps to answer the research question. With this information in hand, the questionnaire was double-checked to make sure that all of the responses had been given accurately and that all pertinent questions had been addressed. The data was then sent to the Smart-PLS software for additional analysis after being coded and structured into a composite construct using the Statistical Package for Social Sciences (SPSS) program. Data analysis covers a wide range of topics and methods that help to describe the facts, find patterns in large amounts of data, create and test hypotheses, and build explanations (Atmatzidou & Demetriadis, 2016).

Structural Equation Modelling (SEM) is a statistical framework that models intricate interactions between direct and indirect observable variables (Atmatzidou & Demetridis, 2016). It includes several models of multiple regression that can show variables as both predictors and responses. Other types of quantitative analysis include correlation, multiple regression, analysis of variance (ANOVA), and multivariate analysis of variance (MANOVA).

The Covariance-based SEM or CB-SEM uses computer software AMOS, Mplus, LISREL, etc. Similarly, the Partial Least Squares-SEM focuses on analyzing variances using the computer software Smart-PLS and ADANCO (Hair et al., 2019). To present the study's facts, identify patterns within the large body of data, develop explanations, and test hypotheses, this study used the PLS-SEM technique. Additionally, PLS-SEM may analyze the link between dependent and independent components utilizing effect magnitude and predictive relevance, two features not available in other quantitative analyses (Hair et al., 2019).

When using PLS-SEM, the evaluation of the measurement model must come before any other analysis procedure. Comparing the established framework with the information collected from respondents is made easier by this activity. In PLS-SEM, reflective and formative constructs are measured using several criteria (Hair et al., 2019). Before it was essential to evaluate the structural model, the study incorporated reflective constructs and tested the validity and reliability of the measuring model. The study examined convergent validity, discriminant validity, internal consistency for dependability, and indicator reliability while ensuring the usage of standard stance processes (Hair et al., 2019).

Hair et al. (2019) state that after confirming the measurement model, the following stage is to evaluate the construct's structural model utilizing the five crucial processes. The process goes as follows: first, a structural model's collinearity is evaluated; second, the significance and relevance of the structural model are evaluated; third, the data's goodness of fit is evaluated; finally, the effect size (f-square) and predictive relevance (q-square) are evaluated. To determine how the independent and dependent constructs, a multi-group analysis was conducted.

4.6. Ethical Considerations

A consent form that happens to be part of the questionnaire was sent to the participants to fill out. That is to say, the researcher obtained the consent of the participants by default once a participant agreed to respond to the questions. Participants were given ample opportunity to think about and ask questions about the information presented. All participants were informed that their information would be kept confidential and that their identities would not be revealed in the dissemination of the study's findings. Participants in the survey were also informed that they are free to withdraw from the study at any time. Additionally, the participants were made to understand that they would not be subjected to any negative consequences as a result of doing so. Participating in this study entailed no risk on the participant's behalf. The information gathered was for research purposes only, and those who were not involved in the study would not have had access to the information gathered. The findings of the study were disseminated to interested parties; however, the identities of those who took part in it were not revealed on any of the dissemination platforms. There are no conflicts of interest related to this study.

4.7. Validity and Reliability

When evaluating the construct validity and reliability of variables, each scale would be examined for internal consistency reliability, convergent validity, and discriminant validity, among other characteristics. The composite reliability would be used to assess the reliability of the internal consistency of the data. Composite reliability with values of 0.70 and above is considered acceptable (Ab Hamid et al., 2017). Confirmatory factor analysis was carried out utilizing the partial least squares (PLS) technique of structural equation modeling to estimate convergent validity (SEM). The factor loadings and average variance retrieved from the data were used to determine convergent validity (AVE).

It is recommended that the item loadings be greater than 0.70 (Ab Hamid et al., 2017). The degree to which a construct is distinguishable from other constructs is referred to as discriminant validity. The constructs must be distinct from one another and reflect a reality not represented by the other constructs to demonstrate discriminant validity. Fornell-Larcker criterion and cross-loadings are proposed to be used to evaluate the discriminant validity of the indicators (Ab Hamid et al., 2017). Heterotrait-Monotrait Ratio (HTMT) and Fornell-Larcker criterion are also recommended. To meet this requirement, the square root of the AVE should be larger than or equal to the highest correlation shared between the construct and other constructs, as proposed by Fornell and Larcker (1981). According to a study conducted by Henseler et al. (2015), cross-loadings and the Fornell-Larcker test are unreliable in detecting discriminant validity difficulties. So Henseler et al. (2015) propose calculating the heterotrait-monotrait ratio (HTMT) of the correlations to see how they differ. The HTMT technique is a prediction of what the true correlation between two constructs will be if they were perfectly assessed in the first place. While values greater than 0.90 indicate a lack of discriminant validity in the path model, a lower and more conservative threshold value of 0.85 is acceptable when the constructs in the path model are theoretically more diverse.

4.9. Chapter Summary

This chapter is primarily focused on the research methodology employed to achieve the research objectives. Firstly, the researcher takes a look at the research design and approach, the population of the study, sampling techniques employed, data collection instruments, ethical considerations, viability and reliability of the constructs, and the data analysis procedure is also outlined.

Second, a random sample of 150 teachers teaching computer programming in northern Ghana was selected to gather the primary data using questionnaires. Lastly, structural equation modeling was used to examine the relationships between the variables.

CHAPTER FIVE

RESULTS AND ANALYSIS

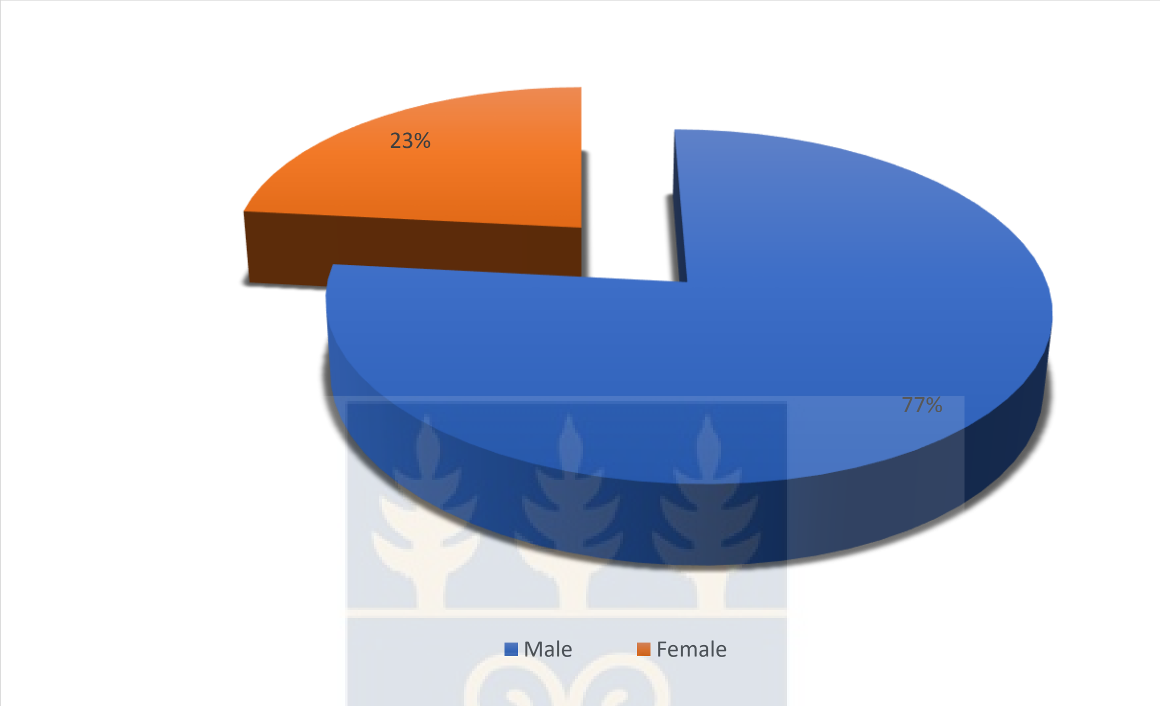
5.1. Chapter Overview

The data analysis, interpretation, and discussion of the findings are presented in this chapter. The chapter is split into three (3) sections, the first of which discusses the demographic characteristics of the study's respondents. The second section delves into the examination of the measurement model for the reliability of indicators; consistency reliability, validity convergent as well as discriminant validity. The rules of thumb for the various measurement are going to be observed in evaluating the results. And the next section focuses on how to evaluate the structural model for Multicollinearity concerns. This includes goodness of fit, path coefficient significance, effect size, and predictive relevance.

5.2 Demographic Characteristics of Respondents

A total of 150 respondents took part in the study, the section provides an extensive representation of the respondent's gender, age, level of education, and the number of years of teaching computer programming in rural Ghana SHSs. The graphs below show information about the demographics of the respondents.

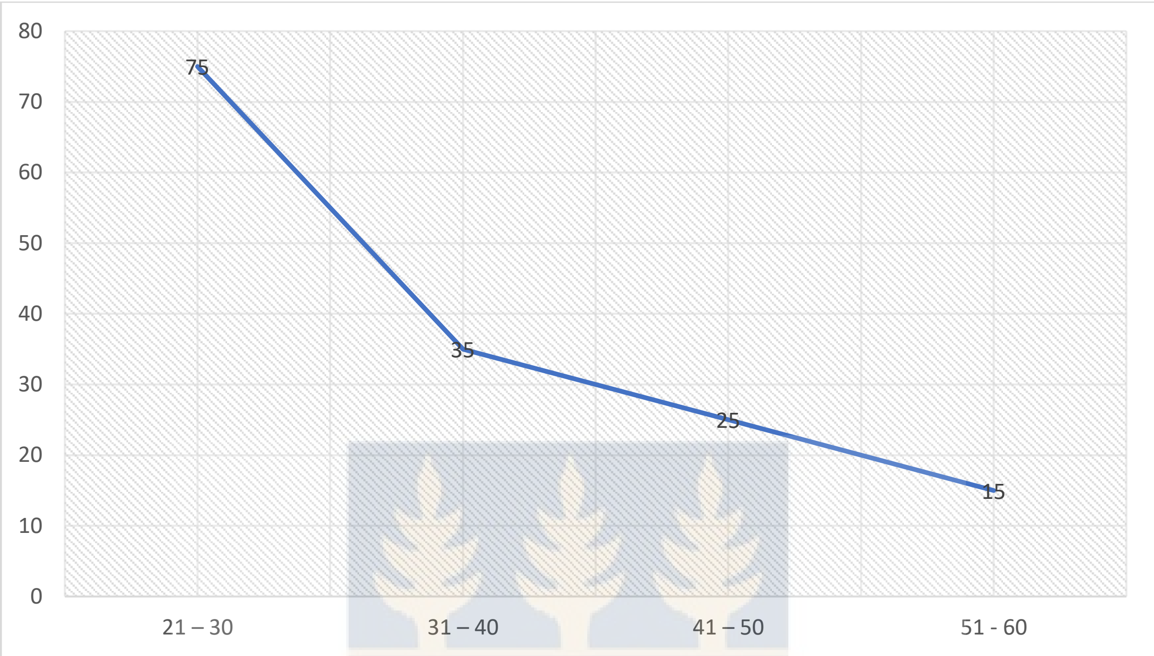
Figure 5. 1 Gender of Respondents



***Source**: Authors' Construction*

From the one hundred and fifty responses received, 115 were males representing 77 percent, and 35 were females representing 23.3 percent. The gender was taken to ensure that opinions of both genders are represented in the study as well as present close to an even representation of all genders and to avoid the study skewing to any particular gender. It is appropriate to mention that the male-to-female ratio is not intentional and it has no effect on the results in any substantial way.

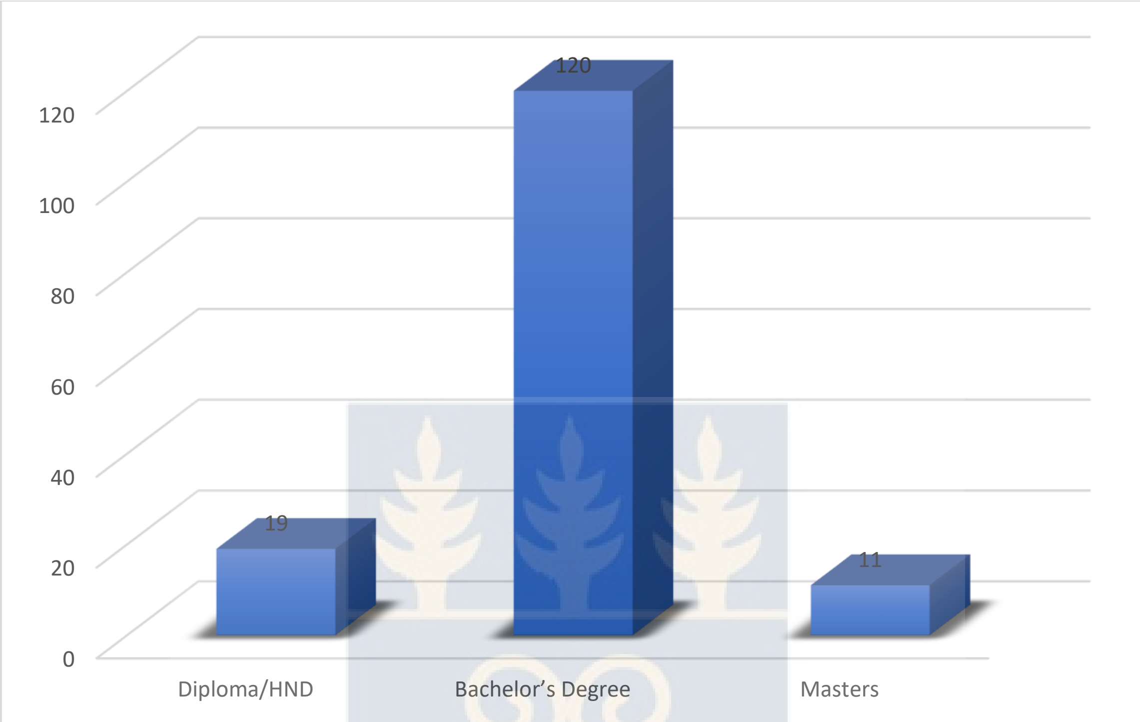
Figure 5. 2 Ages of respondents



***Source**: Authors' Construction*

Figure 5.2 shows the ages of the respondents who took part in the study. The findings show that, of the total one hundred fifty (150) responses, the majority of respondents were between the ages of 21 and 30 (representing 50%), followed by those between the ages of 41 to 50 (16.7%%), and 31 and 40 (23.3%) respectively, and those between the ages of 51 and 60 (10%) representing the least age group.

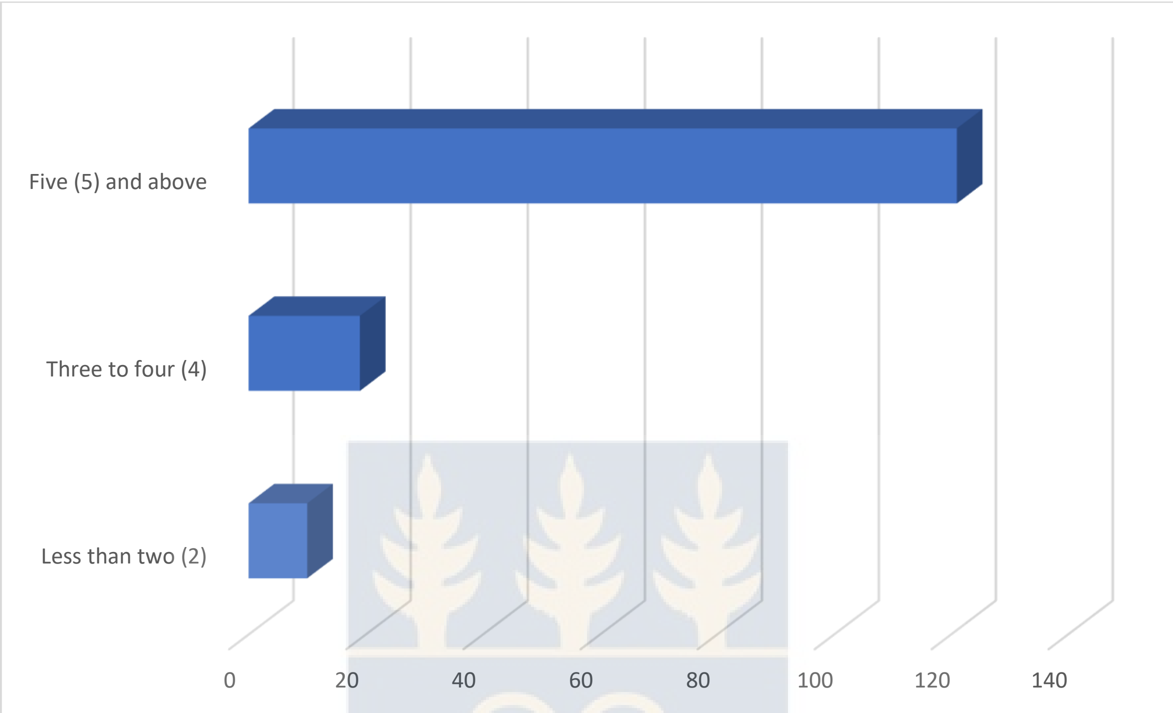
Figure 5. 3 Educational Background of Respondents



***Source**: Authors' Construction*

In terms of the study's respondents' educational attainment, the majority possess a bachelor's degree representing 80 percent of the total responses, this is followed by respondents with a diploma/ Higher National Diploma (HND) representing 12.7 percent, and respondents with Master's degree followed representing 7.3 percent of the total respondents. This is illustrated in figure 5.3 above.

Figure 5. 4 Respondent's Years of experience



***Source**: Authors' Construction*

With regards to the respondent's years of experience in teaching computer programming, the majority of the respondents had [Five (5) and above] experience in teaching computer programming representing 80.7 percent followed by respondents with three [(3) to four (4)] and [less than two (2)] representing 12.7 and 6.7 percent respectively. This is illustrated in figure 5.4 above.

5.3 Assessment of Measurement Model

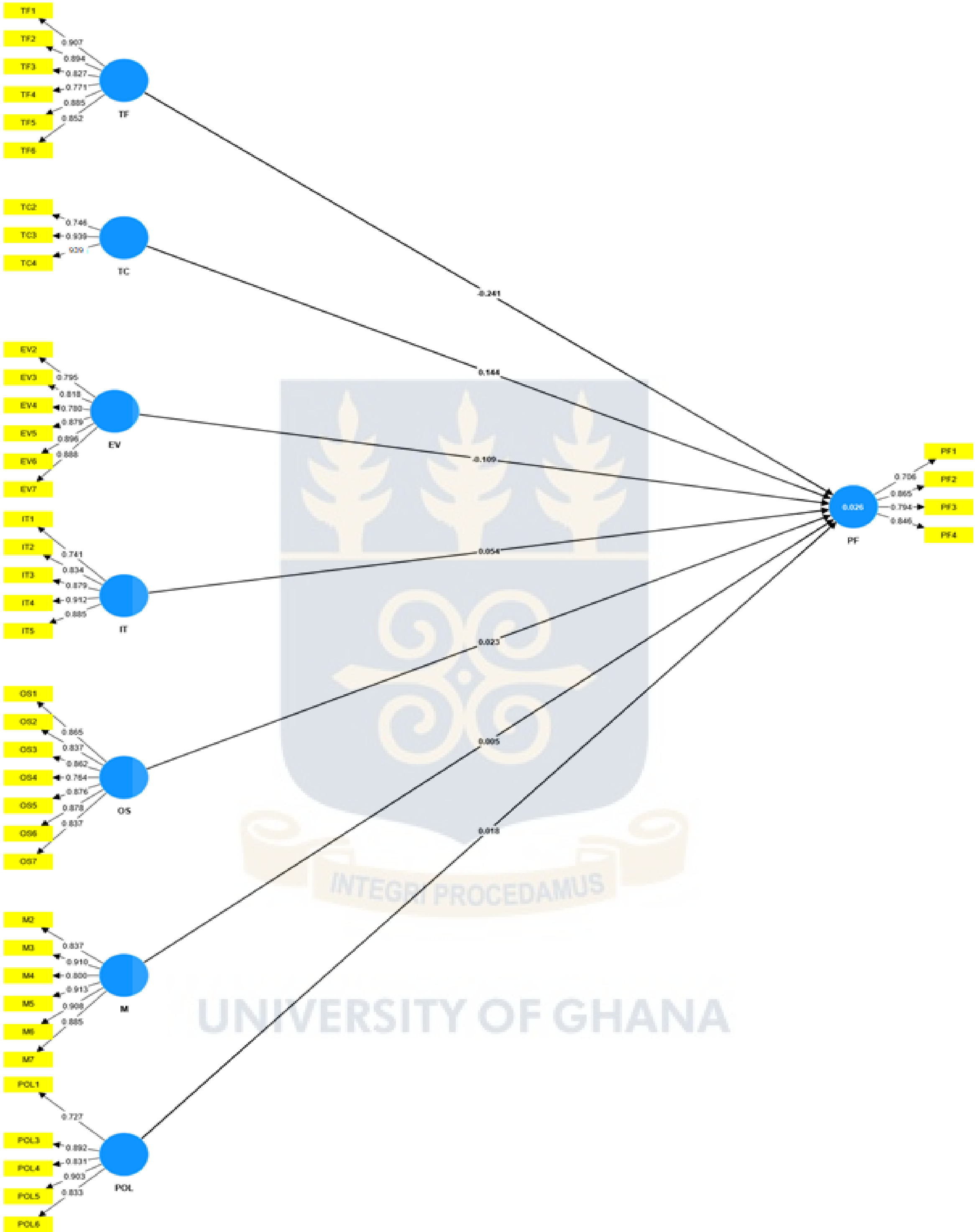
According to Sharma et al. (2021), the assessment of the measurement model in PLS-SEM begins with examining the indicator loadings. The measurement of the assessment model provides the researcher the opportunity to compare the data collected for the study with the adopted theory (Hair et al., 2014; Nouterah, 2022). With all the constructs in this study being reflective, the reliability and validity of the measurement model are needed to be assessed before assessing the structural model. Thus, the indicator reliability, reliability of internal consistency, convergent validity, and discriminant validity was assessed by observing the rules of thumb for all the assessment model.

5.3.1 Indicator Reliability

Sarstedt et al (2020) mentioned that the indicator reliability is first examined during the PLS-SEM analysis. Indicator loadings that are equal to or above 0.70 are maintained whiles any other indicator loadings below the threshold are deleted from the least. Researchers favor indicator loadings above 0.70 because they show that the construct, latent variable, or question explains more than 50 percent of the indicator variation, indicating that the indicator loading is appropriate in terms of item reliability (Sarstedt et al., 2021).

However, with regards to this study, not all the initial indicators loadings were satisfactorily loaded on their corresponding latent variables when the PLS algorithm was first performed. Accordingly, the variables that were less than 0.70 were deleted and the analysis was re-run from the least one after the other until it was left variables that satisfy the threshold. Thus, these variables were deleted: TC5, TC1, PF5, POL2, IT6, EV1, and M1, and these are their corresponding loadings respectively: -0.227, 0.659, 0.549, 0.641, 0.624, 0.674, and 0.674. After the deletions and the remaining variables satisfying the threshold requirement, the results were extracted for the assessment and measurement of the structural model. The figure below (Figure 5.1) shows the indicator loadings after the deletion of the variables whose loadings did not meet the 0.70 thresholds and re-run of the PLS algorithm.

Figure 5. 5 Results of PLS Analysis



Source: Author's construction

5.3.2 Internal Consistency Reliability

After testing for indicator loading accuracies, the internal consistency reliability is the next step. Previous studies have reported on internal consistency reliability using Cronbach Alpha and Rho_A values. However, recent studies (Khan et al., 2019; Hair et al., 2019; Sharma et al., 2019) have criticized the Cronbach alpha and Rho_A values for not being accurate for measuring internal reliability and hence has suggested that Composite Reliability be used (Hair et al., 2019; Sarstedt et al., 2020; Sarstedt et al., 2021). For instance, Cronbach Alpha due to its unweighted elements has been criticized for producing lower values (Sharma et al., 2019; Shiau et al., 2019; Sarstedt et al., 2020). The composite reliability assumes that all the indicators are different and as such has different loadings (Hair et al., 2019), hence making the composite reliability a preferred measure for indicator reliability as compared to Cronbach alpha and Rho_A (Chandra & Kumar, 2018; Hair et al., 2019). Therefore, in this study, composited reliability was employed to assess the internal consistencies of the indicator items as shown in Table 5.2 below.

Concerning composite reliability, higher values represent higher reliability levels. Hence, values between 0.60 and 0.70 are regarded as acceptable for exploratory research. Furthermore, composite reliability values that are between 0.70 and 0.90 represent satisfactory to good and values respectively. Whiles, values that are 0.95 and above are viewed as problematic, this means that the measuring items are beyond what is required. This reduces the construct reliability (Sarstedt et al., 2021). With this study, the results for the composite reliability values range from 0.706 to 0.939 which is translated to mean satisfactory to good. Based on the abovementioned reasons, this study reported on the values of Composite Reliability. Table 5.2 below shows the results for composite reliability and AVE values.

5.3.3 Convergent Validity

Convergent validity is explained as the degree by which the individual items that reflect the construct converges or meet as compared to items measuring different construct (Hair et al., 2019). The Average Variance Extracted (AVE) is used in explaining the Convergent validity (Yoo & Kim, 2019; Odendaal, 1981; Fornell & Larcker, 2016) and this is done across all the items that are associated with the particular measured construct (Sarstedt et al., 2021). The threshold value for the AVE is 0.50, the meaning of this is that 50 percent of the construct explains the variability of its items, therefore convergent validity is acceptable (Hair et al., 2019). Table 5.2 below, presents the AVE values for this study. All the values relating to this study are above the threshold of 0.50, signifying convergent validity was realized for the study.

Table 5. 1 Construct Reliability

Items	Cronbach's alpha	Composite reliability	Average Variance Extracted (AVE)
EV	0.921	0.911	0.612
IT	0.908	0.928	0.626
M	0.940	0.917	0.769
OS	0.931	0.921	0.716
PF	0.816	0.821	0.648
POL	0.914	0.892	0.705
TC	0.928	0.791	0.599
TF	0.930	0.858	0.735

Source: Author's construction

5.3.4 Discriminant Validity

According to Sarstedt et al (2021), discriminant validity can be explained as the extent to which a construct is empirically different from other constructs, be it in terms of how much it is similar to other constructs as well as it being different and distinctly the indicator can represent its construct. PLS-SEM uses the cross-loading results and the Fornell and Larcker (2016) criterion to determine and evaluate the discriminant validity. The cross-loading is the result of the combination of the comparison of the individual latent variable score with all other score items (Dimensión Empresarial, 2017). From Table 5.3, which displays the cross-loading, it can be observed that each construct loading is higher on its own construct than in any other construct or latent variable both vertically and horizontally. This can be explained that the indicators representing the construct are discriminant of each other. Thus, they are not interchangeable. Table 5.3 shows the cross-loading discriminant validity of each construct, loading highest on their allocated construct as compared to any other constructs.

Table 5. 2 Indicator Items Cross-Loading

ITEM	EV	IT	M	OS	PF	POL	TC	TF
EV2	0.818	0.743	0.591	0.680	0.094	0.678	0.680	0.774
EV3	0.895	0.664	0.611	0.632	0.097	0.580	0.611	0.679
EV4	0.780	0.737	0.771	0.747	0.023	0.758	0.637	0.747
EV5	0.879	0.766	0.819	0.770	0.147	0.754	0.720	0.808
EV6	0.896	0.789	0.826	0.767	0.116	0.722	0.733	0.820
EV7	0.888	0.772	0.750	0.742	0.081	0.699	0.652	0.788
IT1	0.627	0.741	0.648	0.580	0.039	0.499	0.614	0.634
IT2	0.692	0.834	0.734	0.690	0.081	0.663	0.608	0.732
IT3	0.755	0.879	0.747	0.717	0.060	0.707	0.741	0.806
IT4	0.868	0.912	0.817	0.852	0.096	0.821	0.850	0.854
IT5	0.759	0.885	0.770	0.812	0.109	0.810	0.738	0.794
M2	0.735	0.771	0.910	0.830	0.061	0.716	0.727	0.763
M3	0.739	0.745	0.957	0.727	0.116	0.746	0.689	0.789
M4	0.717	0.718	0.800	0.681	0.065	0.639	0.685	0.730
M5	0.778	0.823	0.913	0.744	0.083	0.761	0.718	0.850
M6	0.779	0.813	0.908	0.767	0.110	0.792	0.679	0.791
M7	0.783	0.763	0.885	0.747	0.105	0.759	0.615	0.737
OS1	0.741	0.732	0.751	0.835	0.084	0.677	0.762	0.767
OS2	0.764	0.754	0.704	0.867	0.046	0.710	0.773	0.752
OS3	0.811	0.786	0.826	0.862	0.071	0.769	0.668	0.827
OS4	0.533	0.595	0.598	0.764	0.117	0.549	0.516	0.559
OS5	0.779	0.806	0.738	0.876	0.068	0.751	0.753	0.793

OS6	0.753	0.848	0.775	0.878	0.075	0.755	0.716	0.805
OS7	0.731	0.720	0.664	0.837	0.072	0.682	0.717	0.751
PF1	0.027	0.048	0.073	0.004	0.706	0.066	0.037	0.062
PF2	0.087	0.032	0.049	0.057	0.865	0.072	0.036	0.084
PF3	0.143	0.113	0.104	0.118	0.794	0.070	0.105	0.131
PF4	0.140	0.114	0.114	0.127	0.846	0.102	0.090	0.131
POL1	0.730	0.753	0.773	0.744	0.016	0.827	0.727	0.754
POL3	0.763	0.770	0.755	0.737	0.097	0.892	0.765	0.791
POL4	0.792	0.840	0.793	0.751	0.022	0.831	0.705	0.790
POL5	0.691	0.733	0.741	0.722	0.093	0.903	0.676	0.773
POL6	0.688	0.728	0.745	0.710	0.044	0.833	0.740	0.776
TC2	0.718	0.790	0.682	0.822	0.014	0.747	0.936	0.795
TC3	0.855	0.876	0.833	0.847	0.039	0.828	0.959	0.900
TC4	0.744	0.802	0.709	0.791	0.062	0.784	0.979	0.796
TF1	0.819	0.802	0.842	0.776	0.158	0.808	0.688	0.907
TF2	0.813	0.838	0.797	0.789	0.089	0.808	0.771	0.894
TF3	0.802	0.751	0.760	0.740	0.045	0.776	0.753	0.827
TF4	0.753	0.709	0.743	0.759	0.021	0.676	0.659	0.771
TF5	0.779	0.789	0.701	0.758	0.135	0.724	0.775	0.885
TF6	0.803	0.795	0.761	0.808	0.033	0.805	0.866	0.852

Source: Author's construction

The Fornell and Larcker (2016) criterion is another option in PLS-SEM to determine the discriminant validity. Fornell and Larcker (2016) propose that to achieve discriminant validity, the latent variables or items ought to share more variance with the indicators allocated to them. Hair et al (2019) explained further that the AVE should be equated to the squared inter-construct correlation as a measure of the common or shared variance of that same construct and all other reflectively measured constructs in the structural model, thus the shared variance for all model constructs must not be larger than their AVEs. The table below (Table 5.4) shows the Fornell and Larcker- Discriminant Validity results. The results show the latent variables display more variance in their indicators than in any other latent variables. This is shown in the table by the bold numbers. Furthermore, it is evident from Table 5.4 that the bolded values are higher vertically and horizontally. Thus, it can be inferred from that result, discriminant validity has also been achieved by the study.

Table 5. 3 Discriminant Validity (Fornell-Larcker Criterion)

ITEM	EV	IT	M	OS	PF	POL	TC	TF
EV								
IT	**0.872**							
M	0.777	**0.863**						
OS	0.783	0.804	**0.823**					
PF	0.241	0.256	0.398	**0.860**				
POL	0.722	0.497	0.758	0.657	**0.846**			
TC	0.808	0.631	0.538	0.591	0.428	**0.826**		
TF	0.500	0.447	0.423	0.383	0.452	0.385	**0.814**	

Source: Author's construction

In recent years, researchers have consistently highlighted the disadvantages of the Fornell and Larcker criterion for determining discriminant validity (Henseler et al., 2016). The authors added that Fornell and Larcker fail to perform well when the indicator loadings on a latent variable are slightly different. For instance, (when the indicator loadings range from 0.65 to 0.85). With all of the shortfalls of Fornell and Larcker's criterion stated above. Henseler et al (2016) suggested a more appropriate measure for discriminant validity to be the Heterotrait-Monotrait ratio (HTMT) correlations. The HTMT is defined as the mean value of the indicator correlations across constructs relative to the (geometric) mean of the average associations of indicators assessing the same construct (Sarstedt et al., 2021). The HTMT by the Monte Carlo simulation study and results produces far higher sensitive and specific values, 97% and -99% respectively when compared with that of cross-loadings and Fornell and Larker's 0.00% and 20.28% respectively. Studies use a threshold value of 0.90 for discriminant validity (Henseler et al., 2016; Khan et al., 2019; Sarstedt et al., 2021). In cases when the HTMT value exceeds the 0.90 threshold value signifies, missing discriminant validity. However, in such cases, Bootstrapping analysis is used to assess if the HTMT values significantly differ from 1.00 or a lower threshold value such as 0.85 or 0.90, which is mostly defined based on the context of the study (Franke & Sarstedt, 2019; Sarstedt, 2019). Table 5.5 below all the values except one Organizational Support (0.935) correlation exceeded the threshold value of 0.90.

Table 5. 4 Discriminant Validity- Heterotrait-Monotrait Ratio (HTMT)

ITEM	EV	IT	M	OS	PF	POL	TC	TF
EV								
IT	0.546							
M	0.628	0.805						
OS	0.935	0.834	0.416					
PF	0.733	0.713	0.515	0.525				
POL	0.634	0.556	0.652	0.526	0.785			
TC	0.695	0.548	0.811	0.751	0.834	0.645		
TF	0.786	0.759	0.804	0.560	0.718	0.777	0814	

Source: Author's construction

Table 5.6 shows a bootstrapping result to assess if the HTMT values diverge significantly from 1.00 as suggested by (Henseler et al., 2016; Franke & Sarstedt, 2019). From the table, Task Characteristics and their correlation to Performance which the HTMT value was 0.94 lower (0.5%) and upper (95%) limits are 0.82 and 1.01 respectively. From the results, it can be inferred that the correlation between Task and Performance is not discriminant valid (Franke & Sarstedt, 2019).

Table 5. 5 Discriminant Validity: Bootstrapping for Heterotrait-Monotrait Ratio

ITEM	Original sample (O)	Sample mean (M)	Bias	5%	95%
IT -> EV	0.52	0.48	0.00	0.50	0.62
M -> EV	0.53	0.73	0.00	0.70	0.82
M -> IT	0.69	0.44	0.00	0.61	0.59
OS -> EV	0.71	0.35	0.00	0.59	0.63

OS -> IT	0.63	0.37	0.00	0.72	0.74
OS -> M	0.76	0.59	0.00	0.48	0.82
PF -> EV	0.63	0.62	0.00	0.78	0.55
PF -> IT	0.53	0.63	0.00	0.77	0.56
PF -> M	0.65	0.66	0.00	0.76	0.72
PF -> OS	0.85	0.71	0.00	0.83	0.64
POL -> EV	0.74	0.77	0.00	0.71	0.64
POL -> IT	0.86	0.57	0.00	0.65	0.73
POL -> M	0.52	054	0.00	0.57	0.51
POL -> OS	0.56	0.51	0.00	0.49	0.77
POL -> PF	0.85	0.68	0.00	0.79	0.66
TC -> EV	0.85	0.58	0.00	0.56	0.72
TC -> IT	0.58	0.51	0.00	0.69	1.02
TC -> M	0.58	0.62	0.00	0.39	0.72
TC -> OS	0.51	0.53	0.00	0.70	0.78
TC -> PF	0.94	0.94	0.00	0.82	1.01
TC -> POL	0.45	0.48	0.00	0.57	1.05
TF -> EV	0.66	0.70	0.00	0.50	0.74
TF -> IT	0.59	0.60	0.00	0.58	0.54
TF -> M	0.44	0.45	0.00	0.75	0.56
TF -> OS	0.60	0.62	0.00	0.52	0.54
TF -> PF	0.68	0.81	0.00	0.74	0.70
TF -> POL	0.77	0.78	0.00	0.70	0.54
TF -> TC	0.74	0.75	0.00	0.69	0.83

Source: Author's construction

5.4 Structural Model Assessment

After successfully examining the measurement model, the assessment of the structural model is the next step for the analysis of the PLS-SEM results (Hair et al., 2019; Sarstedt et al., 2021). The assessment of multicollinearity issues, path coefficient significance, Goodness of fit, Effect size as well as predictive relevance.

5.4.1 Assessing Structural Model for Multicollinearity Issues

According to Shrestha (2020) whenever there is a combination among predictors in a multiple regression analysis, then there is a presence of multicollinearity. Analysis of the variance inflation factor (VIF) is used in assessing the multicollinearity of each independent construct. VIF values less than 5.0 demonstrates collinearity within a set of predictor constructs (Sarstedt et al., 2021). The VIF values obtained from the PLS-SEM algorithm are less than 5.0 which is the standard threshold, indicates that the existence of a seamless linear combination in the variables that are independent among the construct being observed. Table 5.7 shows a VIF of less than 5.0 for all the values.

Table 5. 6 Multicollinearity Statistics (Inner VIF)

	EV	IT	M	OS	PF	POL	TC	TF
EV					2.725			
IT					1.917			
M					3.059			
OS					1.653			
PF								
POL					4.245			
TC					1.252			
TF					1.775			

Source: Author's construction

5.4.2 Assessing Structural Model for the Significance of Path Coefficient

Assessment of the strength and significance of the path coefficients is evaluated concerning the relationships or structural paths hypothesized between the constructs. The Bootstrapping procedure in the Smart-PLS software was used to assess and analyze the significance of the path coefficient. Bootstrapping, a non-parametric resampling process assesses the variability or erraticism in statistics. It explores the variability in the sample data, instead of using parametric conventions in assessing the correctness of the estimates (Shrestha, 2020; Streukens et al., 2017). Using the bootstrapping procedures, the algorithm was run using a subsample size of 5000 with a 10% or 0.1 two-tailed distribution. The bootstrapping procedure provided t-statistics, to analyze the direct and indirect effects (Hair et al., 2016; Sarstedt et al., 2021). A path coefficient is said to be significant at the 5% probability of error level if zero (0) does not fall in the 95% percentile confidence interval (Sarstedt et al., 2021). With regards to relevance, path coefficients are within -1 and +1, with coefficients nearer to +1 signifying strong positive relationships, and those nearer to -1 signifying strong negative relationships, likewise, values below -1 and above +1 may technically occur, for instance, when collinearity is at critical levels (Sarstedt et al., 2021). From the results, relying on a 95% confidence interval, a critical value of 1.65 or 1.96 is ideal and conventional for a significance level of 10% in a two-tailed test (Hair et al., 2016; Hair et al., 2022). Table 5.8 shows that six (6) of the seven (7) hypothesis t-values were higher than 1.65 or 1.96 meaning their path coefficient is significant. Figure 5.8 demonstrates the same.

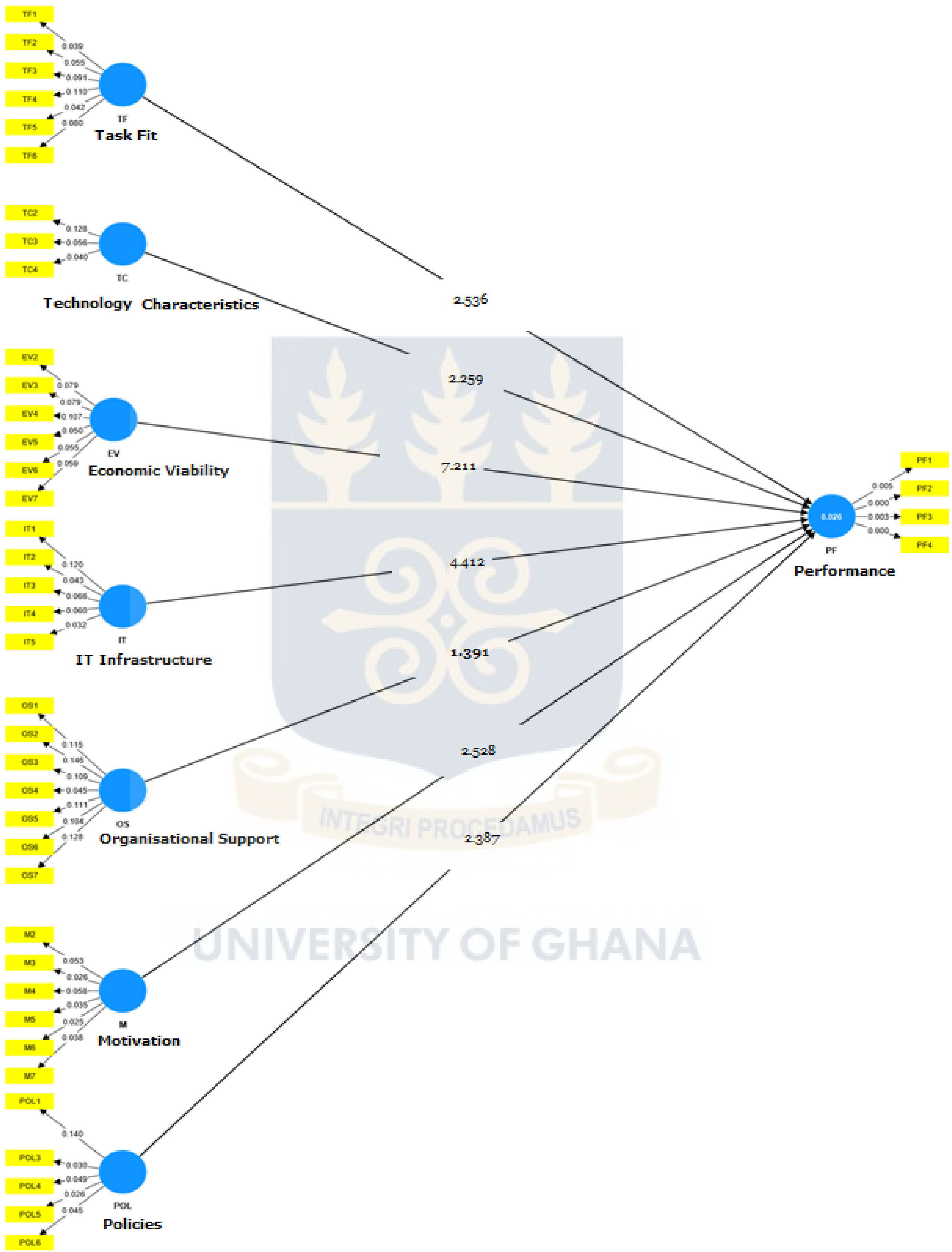
Table 5. 7 Direct Relationships for Hypothesis Testing

	Hypothesis	Std Beta	Std Error	T-Value	Decision	5%	95%
H1	EV -> PF	0.399	0.053	7.211	Supported	0.313	0.486
H2	IT -> PF	0.266	0.073	4.412	Supported	0.162	0.370
H3	M -> PF	0.093	0.037	2.528	Supported	0.034	0.154
H4	**OS -> PF**	**0.076**	**0.052**	**1.391**	**Not Supported**	**-0.009**	**0.620**
H5	POL -> PF	0.100	0.042	2.387	Supported	0.033	0.033
H6	TC -> PF	0.091	0.039	2.259	Supported	0.062	0.411

H 7	TF -> PF	0.086	0.048	2.536	Supported	0.670	0.155

Source: Author's construction

Figure 5. 6 Direct Relationships for Hypothesis Testing



Source: Author's construction

5.4.3 Model Fit

The goodness of fit assessment of the model shows how well-fitted or ill-fitted is the model to the study (Henseler et al., 2016; Sarstedt et al., 2021). The GOF test as well aids in identifying over specifications of the measurement and structural model (Henseler et al., 2015). This study focuses on the R square (R^2) determination coefficient and standardized root mean squared residual (SRMR) to determine the model fit. The R^2 assesses the change explained in the endogenous constructs. Thus, the model's explanatory power is assessed with the R square (Hair et al., 2014). This is sometimes termed the in-sample predictive power (Tripathi & Nasina, 2017b). The R^2 is between 0 to 1, higher levels represent a higher explanatory power. The rule of thumb in explaining the R^2 values is that: R^2 values of 0.75 equal substantials; 0.50 equals moderate; and 0.25 equals weak explanatory power (Henseler et al., 2015; Hair et al., 2019). According to Sarstedt et al (2021), acceptable R^2 values are determined by the study context. For instance, in some disciplines, an R2 value of 0.10 is regarded as satisfactory. An example is the prediction of stock returns (Tripathi & Nasina, 2017a). Similarly, R^2 values above 0.65 are preferred by certain studies. American Customer Satisfaction Index model applications are an example of such studies (Franke & Sarstedt, 2019; Fornell & Larcker, 2016). Ab Hamid et al (2017) an IS researcher classified R^2 values of 0.190 and lower as weak values. Whiles values between the range of 0.333 to 0.660 as average and values of 0.670 as substantial. Furthermore, Sarstedt et al (2021) added that R^2 is directly proportional to the predictor construct. Hence, the more of the predictor construct, the higher the R^2 value. The authors further added that the R^2 should be explained with regards to the context of a study, and as well references and comparisons should be made from extant studies similar to a current study.

Sharma et al (2021) further added that R^2 values in some studies can record very high values in cases of overfitting models. Researchers explain that a model is said to overfit when a partial regression model is complicated and possesses many facets – the consequence of this is that the model rather fits the innate noise of the sample instead of representing the entire population (Sharma et al., 2018; Sarstedt et al., 2021). Table 5.9 presents the R^2 of the current study. The R^2 value for the study is 0.697; IS researchers regard any value from 0.67 as substantial and recommendable (Hair et al., 2019). This is further explained as the combined or total exogenous latent variables represent 69.7% of all the endogenous factor variations (Henseler, 2017; Mohammed et al., 2017).

Table 5. 8 R Squared

	R-square	R-square adjusted
The Teaching of CP in Rural Settings	0.697	0.681

Source: Author's construction

According to Henseler et al (2016), any one of the following metrics can be used to assess and explain the goodness of fit (GoF), they are as follows: the standardized root mean squared residual (SRMR); the unweighted least squares discrepancy (dlus) as well as the geodesic discrepancy (dG). This study chose to use the SRMR with the reason being that SRMR has been widely accepted and used by many researchers in a substantial number of studies as a suitable and apposite measuring instrument for assessing the goodness of fit of a model in PLS-SEM (Odendaal, 1981; Henseler, 2017; Tu & Zhang, 2020). The rule of thumb concerning the SRMR criteria is that the lower the SRMR is closer to zero, the better the model's fit. Thus, an absolute fit is achieved once SRMR is zero. Nevertheless, instances of SRMR value of exactly 0.08 or lower are regarded as satisfactory (Tu & Zhang, 2020; Henseler et al., 2016; Zhang et al., 2021). Studies with SRMR values greater than or beyond 0.08 signifies an absence of fit. From the analysis, the estimated SRMR value for the study is 0.067 as shown in Table 5.10 below, the value is less than the threshold value of 0.08. This then means that the model is well fitted and the model for the study does not contain measurement misspecification.

Table 5. 9 Goodness of Fit (SRMR criteria)

	Saturated model	**Estimated model**
SRMR	**0.065**	**0.065**
d_ULS	5.057	5.057
d_G	6.844	6.844
Chi-square	2345.153	2345.153
NFI	0.620	0.620

Source: Author's construction

5.4.4 Effect Size

The effect size assesses if an independent construct has any significant role in the dependent construct (Yates & Kulick, 1977). The f^2 is the change in the R^2 value when a specific exogenous construct is absent from the model and can be used to assess whether the omitted construct has a substantial impact on the endogenous constructs (Sarstedt et al., 2021). Thus, the f^2 assesses the amount of significance the dependent construct has on the independent construct (Henseler, 2017; Fornell & Larcker, 2016; Chandra & Kumar, 2018). As a rule of thumb, f^2 values between 0.02 and 0.15 represent a small effect size, f^2 values between 0.15 and 0.350 shows a medium effect size, and f^2 values above 0.35 show a large effect size of an exogenous latent variable (Mohammed et al., 2016; Podojil & Cudlín, 1989; Hell & Argyriou, 2019). f^2 values of less than 0.02 means there is no effect (Sarstedt et al., 2021).

From Table 5.11, five (5) of the independent variables: Information Technology Infrastructure (IT), Motivation (M), Educational Policies (POL), Task Fit Characteristics (TC), and Technology Fit Characteristics no effect on the dependent variable – performance. Additionally, Organizational Support and Economic Viability have large and medium effect respectively.

Table 5. 10 f-square

	EV	IT	M	OS	PF	POL	TC	TF
EV					0.37			
IT					0.015			
M					0.016			
OS					0.18			
PF								
POL					0.011			
TC					0.015			
TF					0.006			

Source: Author's construction

5.4.5 Predictive Relevance

The last structural model is the assessment of the predictive relevance. The predictive relevance is the determinant of how the model adequately predicts the endogenous latent variables (Khan et al., 2019; Oliver, 2019). Khan et al. (2019) non-parametric test is used in assessing the predictive relevance, known as the Q-square (q^2). The blindfolding procedure in SmartPLS was run to produce the estimates of the remaining variances by assuming a specific number of cases were absent from the sample. Meaning, after the first blindfolding procedure was run, the predictive relevance included (Q^2 Included) was recorded for all the individual independent variables. Subsequently, the blindfolding procedure was initiated to derive the predictive relevance excluded (Q^2 excluded) for all independent constructs, this was performed by removing the independent construct one after the other and an omission distance of seven (7) was maintained throughout the process in the SmartPLS algorithm. Finally, the formula q^2 = (Q^2 included - Q^2 excluded)/ (1- Q^2 included) (Henseler et al., 2015) was used to generate the predictive relevance of each independent variable on the dependent variable. q^2 values larger than zero are meaningful, whiles values higher than 0, 0.25, and 0.50 depict small, medium, and large predictive accuracy of the PLS path model (Hair et al., 2019). Table 5.12 shows the predictive relevance (q^2) values of the study.

Table 5. 11 Q-square (q^2)

Construct	Q^2 Included	Q^2 Excluded	q^2
EV	0.489	0.444	0.08806
IT	0.489	0.469	0.03914
M	0.489	0.486	0.00587
OS	0.489	0.488	0.00196
POL	0.489	0.485	0.00783
TC	0.489	0.486	0.00587
TF	0.489	0.867	0.00196

Source: Author's construction

5.6 Chapter Summary

The chapter provided an analysis of the data gathered. The chapter began with a detailed report of the demographic representation of the questionnaire respondents. This was followed by an assessment of the measurement model and the structural model for the study.

CHAPTER SIX

DISCUSSIONS OF RESULTS

6.1 Chapter Overview

The preceding chapter presented the empirical findings of the study objectives. This chapter elaborates on the results of the study from the previous chapter to answer the study objectives and questions as stated in the earlier chapters of the study. This chapter discusses the influence of Task, Technology, Economic factors, IT infrastructure, Organizational factors, teacher motivation, and educational policies on the dependent construct performance of computer programming teachers in rural senior high schools in northern Ghana.

6.2 The Teaching of Computer Programming in Rural Ghana

The study is seeking to understand the performance of computer programming teachers in rural Ghana. With the aid of the Fit Viability theory, the study added teacher motivation and educational policies as measuring variables of the theory and relied on 150 responses from the data collected to empirically test the performance of programming teachers in rural Ghana. Out of the Seven (7) hypotheses developed for the study, six (6) were supported and one (1) was otherwise. The supported hypotheses are Economic, Information Technology Infrastructure, Teacher Motivation, Educational Policies, Task, and Technology confirming the hypothesis that the above-mentioned independent constructs significantly influence rural computer programming teacher's performance as stated earlier in chapter three. However, the hypothesis that the support of top management (school) has a positive influence on rural computer programming teachers' performance was not supported, meaning that organizational support does not influence rural programming teachers' performance. Table 6.1 exhibits the results of the hypothesis analysis.

Table 6. 1 Summary of Hypothesis Testing

	Hypotheses	Std Beta	Std Error	T-Value	Decision	5%	95%
H1	EV -> PF	0.399	0.053	7.211	Supported	0.313	0.486
H2	IT -> PF	0.266	0.073	4.412	Supported	0.162	0.370
H3	M -> PF	0.093	0.037	2.528	Supported	0.034	0.154
H4	**OS -> PF**	**0.076**	**0.052**	**1.391**	**Not Supported**	**-0.009**	**0.620**
H5	POL -> PF	0.100	0.042	2.387	Supported	0.033	0.033
H6	TC -> PF	0.091	0.039	2.259	Supported	0.062	0.411
H7	TF -> PF	0.086	0.048	2.536	Supported	0.670	0.155

Source: Author's construction

6.2.1 Task Characteristics

Using the threshold of the 't-value' for the basis of the discussion, it can be observed that the hypothesis is supported. Hence, task characteristics significantly influence the performance of teachers teaching computer programming in rural SHSs in northern Ghana. The corresponding t-value for the relation between task characteristics and rural teacher performance was 2.259. This implies that the task characteristics of teachers teaching computer programming in rural SHSs in northern Ghana are a major influencer on teacher performance on the subject (CP). Task characteristics, therefore, include those that might require the teacher to depend heavily on Information Technology (the internet, programming Apps, projectors, etc.) for teaching and learning in rural areas.

Yoo and Kim (2019) study confirmed that task characteristics influence Fit and subsequently influence the performance or adoption of cloud computing. The findings of this study about task characteristics corroborate extant studies that have employed the FVT such as Larosiliere and Carter (2016) and Mohammed et al (2017).

6.2.2 Technology Characteristics

The relation between technology characteristics of fit and teachers teaching computer programming in rural SHSs in northern Ghana was also supported. The t-value for the relation was 2.536 and this indicates that the hypothesis is supported. The hypothesis implies that technology characteristics, in this instance 'the performance of rural CP teachers', significantly influence the teacher's lesson delivery. Larosiliere and Carter (2016) defined technical characteristics as the ICT employed within an organization in performing a task. The authors added that these technologies are suitable tools, services, and online resources that enable classroom instructions, student-teacher-equipment engagement, communication, interaction, and participation within the school. The technology further serves as an avenue for interaction and facilitates quality lesson delivery. Yoo and Kim (2019) mentioned that when the technology and the task characteristics are in tangent there is an increase in usage of the technology as well as a positive performance.

Similar IS research studies have produced analogous findings that support the technology characteristics on the performance of a system (Mohammed et al., 2017; Larosiliere & Carter, 2016). For instance, Larosiliere and Carter (2016) study adopted the Fit-Viability Framework to assess the maturity of the government process from different countries. The research findings showed higher levels of significance between technology and the overall usage of the system. Findings from this study similarly demonstrated that technology characteristics such as availability and convenience of the technology as well as the easiness of operating the technology, enable teachers to increase their lesson delivery. Thus, the study confirms that the use of a technology approach to teaching programming at the SHS level impacted positively teachers' performance.

6.2.3 Economic Factors

The third hypothesis postulates that *economic well-being has a positive influence on computer programming teachers' performance in rural Ghana SHSs.* Economic factor measures the degree to which economic conditions influences performance (Larosiliere & Carter, 2016). The corresponding t-value was 7.211, which implies that economic conditions significantly support the teachers teaching computer programming in rural SHSs in northern Ghana. This means that the prevailing economic conditions of the school (SHS) influence the programming teacher's performance. This manifest in the purchase of hardware (laptops, projects, desktops, tablets, etc.) to access the technology as well as the purchase of internet data or Wi-Fi to download the application for upgrading the hardware infrastructure as well as maintenance of the application. Additionally, extant studies have produced similar outcomes (Tripathi & Nasina, 2017b), from their study, reported that economic well-being significantly influences the performance of computer programming. This outcome is consistent with the study findings by Larosiliere and

Carter (2016), who stated that economic well-being impacts the overall readiness, implementation, and usage of IT in all sectors and endeavors.

6.2.4 Information Technology Infrastructure

Mohammed et al. (2016) define IT infrastructure viability as IT resources that influence the adoption, usage, and performance of new technology or system in an organization. The result from the current study was consistent with the hypothesis. The t-value corresponding to the hypothesis was 4.412, which falls far above the threshold value of 1.65 or 1.96, hence the hypothesis was supported. This can be explained such that with regards to teachers teaching computer programming in rural SHSs in northern Ghana can optimally increase their performance in their respective institutions.

Chavoshi and Hamidi (2019) observe that IT infrastructure in itself is not enough in influencing the usage of new technology in any organization. However, Mohamed et al (2016) as well as Larosiliere and Carter (2016) findings prove that IT infrastructure poses a significant influence on the performance of information technology. For instance, Larosiliere and Carter (2016) reported that IT infrastructure contributes to the largest among the viable resources in their study to investigate electronic government maturity and its determinants in the United States of America. The findings of the study demonstrated that IT infrastructure is critical in teachers' lesson delivery and the performance of information technology systems within business organizations. Nevertheless, the above-mentioned study was carried out in a developed country. Such findings cannot represent developing countries' perspectives or be generalized to all countries. Since there are differences in culture, legislation, education per capita, and technological infrastructure. This current study is providing a perspective from a developing country.

6.2.5 Organizational Factors

Furthermore, the fifth hypothesis of this study postulated that *the support of the top management (school/organizational support) has a positive influence on teachers teaching computer programming in rural Ghana SHS.s*. Mohammed et al (2016) and Zaki et al (2013) define organizational viability as the readiness and availability of the needed organizational resources for the adoption of new information technology. Likewise, academic institutions need to be ready and adequately prepared with resources and technological devices such as tablets, projected screens, projected, laptops, and smartphones during lessons delivering or for instructions.

The results of other studies (Yoo & Kim, 2018; Liang et al., 2007; Mohamed et al., 2016; Larosiliere & Carter, 2016) have produced results that are consistent with the current studies' findings. For instance, Larosiliere and Carter (2016) study findings demonstrated that the viability dimension of an organization has a significant relationship with government performance. The study findings further suggest that the right organizational support and encouragement can blossom teachers' lesson delivery. However, the result of the current study was contrary to the hypothesis. The t-value corresponding to the hypothesis was 1.391, which falls short of the threshold value of 1.65 or 1.96, hence the hypothesis was rejected.

6.2.6 Teacher Motivation

The sixth hypothesis postulates that *teacher motivation significantly improves the performance of teaching and learning computer programming in rural Ghana SHSs*. Podojil and Cudlín, (1989) define motivation as the "psychological processes that cause the arousal, direction, and persistence of behavior". Ganta (2014) further added that motivation is 'how to provide something to a person to drive him/her to do something. In the two-factor theory, motivation is the variable most strongly correlated with job satisfaction. Herzberg and his colleagues argued that to increase employees' job satisfaction the motivation factors must be improved (Podojil & Cudlín, 1989; Tokarz & Malinowska, 2019; Ganta, 2014; Nikula et al., 2011). The motivators, as Herzberg's theory called them, are inherent to the profession and might result in favorable attitudes toward it because they gratify the "desire for progress or self-actualization" (Nikula et al., 2011; Herzberg, 1966, p. 75). Ganta (2014) opines that motivation factors are related to a person's job satisfaction and include advancement, the work itself, the possibility of growth, responsibility, recognition, and achievement.

The hypothesis t-value results for teacher motivation impact on teacher's performance was 2.528, signifying that the hypothesis is supported. This implies that teacher motivation is a significant influencer on teachers' lesson delivery and performance. Extant studies (Khan et al., 2019; Oliver, 2019) have discussed the impact of IT/CP teacher motivation and pedagogy in rural settings. According to Oliver (2019), unmotivated workers (programming teachers) are more likely to put in little to no effort at work, which can lead to bad performance. They will also avoid going to work as much as possible, leave school if given the chance, and create subpar work. Teachers who are motivated to work, on the other hand, are more likely to be consistent, creative, and productive, producing high-quality performance (Joseph et al., 2013).

Additionally, Ganta (2014) and Sarstedt et al (2020) in their studies have reported on the significance of employees' need for motivation to feel good about their jobs and perform optimally. Likewise,

Khan et al (2019) as well as Oliver (2019) and Joseph et al (2013) added that some employees are money motivated while others find recognition and rewards personally motivating. Motivation levels within the workplace have a direct impact on employee productivity. Workers who are motivated and excited about their jobs carry out their responsibilities to the best of their ability and productivity increases as a result. This finding, therefore, sheds light on the different perspectives on teacher motivation tools.

6.2.7 Educational Policies

Educational policies are the seventh and last of the viability measurement for this study. Abdulai and Hickey (2016) define the concept of educational policies as the choices that affect the field of education as well as the body of laws and regulations that control how educational systems are run. Abukari et al (2015) and Buabeng et al (2020) further added that these educational policies may have an impact on all stakeholders' involvement, particularly teachers. For instance, education policy, specifically in the context of schools, includes instructional materials, school-infrastructure investment, employment of teachers, training, and certification, salary, curriculum content, and graduation standards.

The hypothesis in chapter three postulates that *educational policies significantly influence the performance of computer programming in rural Ghana Senior High Schools.* The result was 2.387. This means that the hypothesis is supported. From the results, it can be concluded that favorable educational policies for rural areas of Ghana can result in optimal CP teacher performance.

This study finding affirms the study by Buabeng et al (2020) and the World Bank (2011b) which observed that a nation's educational policy and future growth prospects are positively correlated with the educational policies of that country. This is because a well-informed populace is better equipped to formulate strategies, create and employ tools, and use resources to force socioeconomic growth (Abukari et al., 2015; Buabeng et al., 2020). All citizens must have equal access to opportunity and education to develop these skills. This point of view is consistent with the World Bank's assertion that "continued poverty reduction needs the commitment to eliminate inequality and improve access to opportunities for all residents"(Turchi et al., 2019; World Bank, 2015).

6.2.8 Chapter Summary

This chapter expounded the findings from the analysis by juxtaposing the findings of the study with the hypotheses as well as extant literature. This aided in answering the research questions. The objective of this assessment was to extract and highlight the degree to which the stated hypotheses are supported or not regarding the teaching of computer programming in rural Ghana SHSs.

CHAPTER SEVEN

SUMMARY CONCLUSION AND RECOMMENDATIONS

7.1. Chapter Overview

The preceding chapter focused on explaining the analysis of the study by comparing the findings from the analysis with the hypotheses of the study as well as with extant literature. This chapter which is the last summarizes the study and presents the answers in response to the research questions. The chapter proposes some recommendations for future studies to consider and present the limitations of the study.

7.2 Review of Previous Chapters

The purpose of this research was to explore the performance of computer programming teachers in rural Ghana Senior High Schools in the northern part of Ghana. As mentioned in Chapter 1, it was observed by the researcher that despite the many investigations performed by information systems (IS) researchers, there remained some substantial gaps that needed attention. For instance, extant research on computer programming has largely been focused on developed countries known as the Western, Educated, Industrialized, Rich, and Democratic (WEIRD) countries. Therefore, research is required to examine how computer programming teachers handled the subject (CP) in rural settings since the project's inception 15 years ago in Ghana, particularly in the northern part of Ghana. Secondly, Bers (2018) lamented recent discussions over the teaching of programming in rural schools and asserted that earlier research had yielded contradictory results. Therefore, there is a need for future research on a large scale using various methodologies. In addition, numerous calls have been made for further research on the teachers who teach computer programming in rural settings to employ theories to explain the studies and better build on the findings. Additionally, extant research revealed that programming has consistently been a challenge everywhere, particularly in rural places. Learning to program has a high failure rate and high dropout rate.

Chapter two, extant literature on computer programming was reviewed. It was discovered that many prior studies have focused on computer programming implementation; little is known, however, about the institution's readiness, teachers' subject-matter competence, and preparation of the teachers in these institutions (rural SHSs). In other words, the subject's performance has not been evaluated in light of the institution's readiness and the subject-matter expertise of the teachers.

Chapter three discussed the Fit-viability theory, in addition, some limitations of the theory were discussed. The theory was chosen to help explore how the Task, Technology, Economic, IT Infrastructure, and Organization fit the requirement of the teaching of CP in rural areas at the SHSs level in a developing economy. The viability of the organization's finances, infrastructure, and economy was also examined. Additionally, the theory was extended to include additional two independent variables (teacher motivation and educational policies) to measure the performance of teachers who teach computer programming in rural Ghana SHSs. The motive for choosing the FVT was based on the fact that its constructs can measure how fit and viable the teaching of CP in rural Ghana SHSs is. Similarly, the theory was adapted to help unravel factors that influence the teaching of CP in rural Ghana SHSs as indicated above.

In chapter four the research methodology and approaches were discussed. The chapter expounded on the three major paradigms mostly employed in information systems research (positivist, interpretivism, and critical realism). The ontology, epistemology, and methodology were discussed as well. Upon the discussions, the positivist approach was then chosen as the preferred paradigm for the study. Furthermore, the research approach, sampling approach, data collection technique, and analysis technique for the study was established in this chapter.

Chapter five analyzed the gathered data and presented the findings. Before the analysis of the data began, the data went through a cleaning process to eliminate any incomplete data set. Then after the SPSS algorithm was used to analyze the demographic composition of the data, after which the Smart-PLS algorithm was used to analyze the data findings to glean answers to the research questions. The outcome of the research analysis revealed that all except one of the hypotheses being tested were positively significant.

Chapter six which happens to be the penultimate chapter, focussed on explaining the findings of the analysis. The findings of the study were compared with extant literature, to affirm the hypotheses of the study.

7.3 Answers to the Research Objectives/Questions

The findings of the study are presented based on the objectives of the research. The first objective is to investigate the fit and viability characteristics of the teaching of computer programming in rural Senior High Schools in northern Ghana. Secondly, to assess the level of teacher motivation towards the teaching of computer programming in rural Senior High Schools in northern Ghana, and finally, to examine the effectiveness of the educational policies in the teaching of computer programming in rural Senior High Schools in northern Ghana.

7.3.1 The Fit and Viability Element

Reviewed literature on the fit and viability characteristics of the teaching of computer programming in rural Senior High Schools in northern Ghana revealed that there is a huge gap in the teaching of computer programming in rural areas. The literature showed a statistically significant difference between the mean marks of participants from rural schools and their counterparts in the urban cities during the experiments that used 3D animation in the teaching of computer programming. This study, however, concentrated on teachers who teach CP in rural Ghana SHSs in the northern part of Ghana. The study observed that task characteristics of teachers teaching computer programming in rural SHSs in northern Ghana are a major influencer on teacher performance on the subject (CP). Task characteristics, therefore, include those that might require the teacher to depend heavily on Information Technology (the internet, programming Apps, projectors, etc) for teaching and learning in rural areas. The findings of this study concerning task characteristics corroborate extant studies that have employed the FVT.

Furthermore, related extant literature indicates that the phenomenon (issues of CP in rural SHSs) is very common in Sub-Saharan Africa (SSA) and Central America rural SHSs. Statistics show that failure and withdrawal rates in CP exceed 50%. Accordingly, the overall pass rate of CP the first time was 40% across all majors, with a 19.5 % initial failure rate and a 40.5 % withdrawal rate. The worldwide average pass rate of an introductory computer programming course is approximately 67.7%. This situation is supported in this study by the t-value 2.259 in Table 6.1.

7.3.2 Teacher Motivation Tools

The second research objective/question was to assess the level of teacher motivation tools towards the teaching of computer programming in rural Senior High Schools in northern Ghana. The PLS-SEM algorithm was used to analyze the developed hypothesis for the study. The conceptual model is built from the construct of the FVT framework and two additional constructs were added (teacher motivation tools and educational policies) to the FVT framework to aid in assessing the teaching of computer programming in rural Senior High Schools in northern Ghana.

The findings are that Task, Technology, Economic conditions, Organizational Factors, teacher motivation tools, and educational policies were statistically significant to aid teachers teaching computer programming in rural Ghana. However, Hypothesis (H4) which is organizational support, was found to be statistically insignificant as shown in Table 6.1. Table 6.1 provides the t-values for all the hypotheses developed for the study.

7.3.3 Educational Policies

The third and final research objective/question was to examine the effectiveness of educational policies in computer programming education in rural Senior High Schools in northern Ghana. A study was conducted to assess students' performance in computer programming. The findings revealed that students have good knowledge of Mathematics, which is critical for acquiring computer programming skills. It was also revealed that most of the sampled schools that had "RLG Laptops" were not functioning. Instructional / ICT equipment such as computer laboratories, projectors, printers, and textbooks was rarely found. However, this study investigated the influence of educational policies in computer programming education in rural ghana SHSs. It was revealed from the study that educational policies significantly influenced the performance of teachers who teach in rural SHSs.

7.4 Mapping Research Objectives to Findings and Contributions

Table 7.1 provides a summary of the study findings about objectives of the study.

Furthermore, the contributions, implications, and recommendations of the study are outlined.

***Table 7. 1** Mapping Research Objectives to Findings and Contributions*

Research Objectives	***Research Findings***	***Extant Supporting Literature***	***Contributions, Implications, and Recommendations***
To investigate the fit and viability characteristics of the teaching of computer programming in rural Senior High Schools in northern Ghana.	❖ The study observed that task characteristics of teachers teaching computer programming in rural SHSs in northern Ghana are a major influencer on teacher performance on the subject (CP). ❖ The findings indicated that the economic conditions of the school (SHS) influence the programming teacher's performance. ❖ The findings discovered that the use of a technology approach to teaching programming at the SHS level impacted positively teachers' performance. ❖ The findings revealed teachers teaching computer programming in rural SHSs in northern Ghana can optimally increase their performance in their respective	The findings of this study concerning task characteristics corroborate extant studies that have employed the FVT (Larosiliere & Carter, 2016; Mohammed et al., 2017).	This study contributes to the body of knowledge on the development of computer programming in rural areas by investigating how teachers in rural areas approach the subject (CP) in developing countries like Ghana. This study demonstrates the need for IS researchers to carry out additional research on determining the need for computer programming education, particularly in less developed nations. The application of the fit viability theory also encourages researchers to pay more attention to the task and technology aspect of the teaching of computer

	institutions given the needed IT tools. ❖ The findings revealed that there is a huge gap in the teaching of computer programming in rural areas.		programming and the performance of teachers who teach programming
To assess the level of teacher motivation towards the teaching of computer programming in rural Senior High Schools in northern Ghana.	❖ The findings revealed that teacher motivation tools are statistically significant to aid teachers in teaching computer programming in rural Ghana. ❖ These findings found that teacher motivation is a significant influencer on teachers' lesson delivery and performance.	Extant studies by Agyapong and Ojo (2018) and Al-emran et al (2021) supported this assertion.	This finding, therefore, sheds light on the different perspectives on teacher motivation tools.
To examine the effectiveness of the educational policies in the teaching of computer programming in rural Ghana Senior High Schools.	❖ The findings concluded that favorable educational policies for rural areas of Ghana can result in an optimal CP teacher's performance.	This study's findings support research by Avidov-ungar et al (2022) and Bakar and Mukhtar (2019), which found a favorable correlation between a nation's	The contribution of this study to research would enable the government to make better decisions on the distribution of IT equipment

❖ The findings revealed that Task, Technology, Economic conditions, and Organizational Factors have a direct detrimental effect on the teaching of computer programming in rural Ghana SHSs.	educational policies and its prospects for future growth.	to underprivileged rural SHSs and communities.
❖ Furthermore, the findings of the current study were contrary to hypothesis H4 (Organization Support on performance). Hence the hypothesis was rejected.	(Bers, 2018; Becker & Quille, 2019; Gray et al., 2019).	

Source: Author's construction

7.5 Research Contributions and Implications

7.5.1 Implications to Research

In terms of research, this study contributes to the body of knowledge on the development of computer programming in rural areas by investigating how teachers in rural areas approach the subject (CP), which in developing countries like Ghana had received little attention. This study demonstrates the need for IS researchers to carry out additional research on determining the need for computer programming education, particularly in less developed nations.

Again, the application of the fit viability theory also encourages researchers to pay more attention to the task and technology aspect of the teaching of computer programming and the performance of teachers who teach programming. Additionally, the task-technology fit has demonstrated that the fit between the characteristics of task and technology can lead to increased performance of programming teachers in rural locations.

Furthermore, issues on the viability dimension include economic factors such as budgetary allocations for the purchase of IT equipment (e.g. laptops, projects, desktops, tablets); IT infrastructure viability such as the need for the country to have a robust IT infrastructure maturity and government support; organizational factors such as management structure, readiness, support and allocation of funds.

Again, the theory enhances the assessment of teachers teaching CP in rural Ghana based on established factors that affect the performance of the project implementation in these deprived areas. Further, the study establishes the need for IS researchers to extend their studies to other aspects including the competence level of the teachers, students (in rural areas) interest in the subject, and other social factors that serve as hindrances to the implementation of the project rather than studies focusing more on only the difficult nature of the subject.

7.5.2 Implications to Practice

From the framework used for the current study. The study identified different factors that influence the teaching and performance of CP in rural SHSs in the northern part of Ghana. Hence, this study believes it is important to specify the implications of these factors on the country's rural SHSs communities. By utilizing the 't-value' threshold, it is noted that the hypothesis is supported based on the SmartPLS outcome of the study analysis. Therefore, task features have a major impact on how well teachers who teach computer programming in rural SHSs in northern Ghana perform in their respective roles. This suggests that a significant factor affecting teacher performance in the subject is the task characteristics of teachers teaching computer programming in rural Ghana SHSs.

In light of this, the study urges the Ministry of Education (MoE), Ghana Education Service (GES), and other stakeholders or agencies involved in the education sector to invest enough funds for computer programming education in these underdeveloped areas of the country. This can result in better subject (CP) performance for teachers working in these outlying locations as well as students.

Additionally, there was evidence to establish the relationship between technology characteristics of fit and teachers teaching computer programming in rural SHSs in northern Ghana. The hypothesis implies that technological variables, in this case, "the performance of rural CP teachers," have a substantial impact on how well teachers deliver lessons. The technology also provides a channel for communication and makes it easier to give high-quality teaching. To improve the effectiveness of teachers in these remote communities, the study advises the MoE and the GES to pay greater attention to the technological peculiarities of these rural locations.

The research also demonstrates that a school's economic situation considerably supports the teachers who teach computer programming in rural SHSs in northern Ghana. This indicates that the performance of the rural programming teachers is influenced by the area's economic conditions at the school (SHS). As a result, institutions (schools) or educational organizations are urged to participate in CP education initiatives in underdeveloped areas of the country.

The study's results also showed that organizational factors, teacher motivation tools, and educational policies all have a positive effect on how computer programming is taught in rural Ghanaian SHSs. This suggests that the MoE, GES, and other relevant stakeholders are urged to create an environment that will allow computer programming to be effectively taught in these underdeveloped areas.

7.5.3 Implications to Policy

Policy establishment and implementation should take place within the Ghana educational framework. Communities in the "haves" and "have-nots" have different perspectives and resources. Hence the country's educational policies should not be formulated solely based on the wealthy and "developed" communities/schools.

Finding practical ways to include rural Ghana SHSs, and particularly northern Ghana rural SHSs, in policy formation is an issue that still requires careful scientific examination. The "underdeveloped" rural schools in Ghana must be empowered to comprehend challenges like the unavailability of IT infrastructure, dependable energy, and well-equipped computer systems, as well as to create a shared understanding for these remote schools' growth and development, it is necessary to empower Ghana's "underdeveloped" rural schools.

This study will help the government to provide effective guidelines to enhance its decision-making on the provision of IT equipment to deprived rural SHSs/communities. Another implication for policy is that implementing agencies in developing economies need to consider the procedures and processes that best work in their countries to close the gap between SHSs found in the rural areas of their respective country (ies). The study established that IT infrastructure; technical competence, and well-resourced ICT laboratories across the country should be critically looked at before extending (including) the subject (CP) to remote areas of the country.

7.6 Limitations and Future Research Directions

Despite the intriguing results of this study, it must be acknowledged that it has significant limitations, just like all other research investigations. First, the study focused on only rural Senior High Schools in the northern part of Ghana. As such, there is a need for future research to focus on the southern rural part of the country.

Additionally, the study focused on exploring teachers who teach computer programming in rural Ghana SHSs. The focus of future research should be on students' performance in the subject (CP). Additionally, due to time and resource constraints, the private SHSs were excluded from this study. Thus, future research should concentrate on private SHSs.

Furthermore, the study used a quantitative approach. Future research should consider applying a qualitative methodology to elicit in-depth personal interpretations and experiences to contrast with the results of the current study. Since the qualitative methodology produces rich insights and experiences, this also helps in generalizing the study's conclusions.

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APPENDICES

QUESTIONNAIRE

"Towards the Teaching of Computer Programming in Rural Ghana: Teacher Motivation Tools and Policy. A Case of Senior High Schools in Northern Ghana".

This questionnaire has been designed to research the above topic for academic purposes. All information provided will be used solely and exclusively for academic purposes and would be treated with the necessary confidentiality it deserves. Information provided would be used to make sound empirical analysis to understand teacher motivation, tools, and policies driving the teaching of computer programming in High Schools in Ghana.

All questions and comments regarding this research should be directed to me via sabiam@st.ug.edu.gh

Thank you for your cooperation.

SECTION A

Socio-Demographic Characteristics and Academic Background

Please tick [√] where appropriate.

1. Gender: Male [ ] Female [ ]

2. Age: 21 -30 [ ], 31 - 40 [ ], 41 - 60 [ ]

3. What is your level of education? Diploma/HND [ ], Bachelor [ ], Masters [ ], Doctorate [ ]

None [ ], please specify others ……………......................................

SECTION B

Knowledge about computer programming, number of years of experience in teaching computer programming (please tick [√]) where appropriate.

1. Do you have knowledge of computer programming?

   Yes [ ]

   No [ ]
2. Do you have instructional materials/equipment for the teaching of computer programming?

   Yes [ ]

   No [ ]

3. What programming language (s) do you use for teaching your students?

   ____

4. How long have you been teaching computer programming in this school?
   a) Less than two (2) years.
   b) Three (3) to four (4) years.
   c) Five (5) years and above.

5. Have you ever taught computer programming without using computers?

   Yes [ ]

   No [ ]

6. Are there clear local policies that support the teaching of computer programming in your school?

   Yes [ ]

No [ ]

7. Does the school environment motivate you to teach computer programming?

Yes [ ]

No [ ]

SECTION C

The following questions seek to ascertain respondents' perceptions about the teaching of computer programming in rural Ghana.

Please show how you agree or disagree with the following statements 1=Strongly Disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree.

	CONSTRUCT	**1=Strongly Disagree**	**2=Disagree**	**3=Neutral**	**4=Agree**	**5=Strongly Agree**
	Task Fit	**1**	**2**	**3**	**4**	**5**
TF1	Teaching programming improves my teaching skills.					
TF2	Teaching computer programming allows for multitasking.					
TF3	It is easy to teach computer programming effectively.					
TF4	Teaching programming fits my teaching style.					
TF5	Knowledge of programming increases my cognitive processing speed.					
TF6	Teaching computer programming is useful to my career.					
	Technology Fit Characteristics	**1**	**2**	**3**	**4**	**5**
TC1	Teaching computer programming requires the use of special hardware and software.					
TC2	Teaching computer programming would require a special environment equipped with new technological devices.					
TC3	The Integrated Development Environment (IDE) is user-friendly and simple.					
TC4	Teaching computer programming is easy and simple.					
TC5	Teaching computer programming requires much time and training.					
	VIABILITY					
	Economic	**1**	**2**	**3**	**4**	**5**

EV1	There are enough financial resources for the teaching of computer programming in my school.					
EV2	It is expensive to repair or replace broken-down ICT equipment.					
EV3	There is external support (PTA/Alumni/NGO) to support the teaching of computer programming.					
EV4	The PTA provides financial support to the ICT department to enable the teaching and learning of computer programming in my school.					
EV5	Alumni frequently support the ICT department with ICT equipment in support of the teaching and learning of computer programming in my school.					
EV6	NGOs and philanthropic organizations do donate ICT equipment to support the teaching and learning of computer programming in my school.					
EV7	Top managementt invests funds for retraining computer programming teachers in my school.					
	IT Infrastructure	**1**	**2**	**3**	**4**	**5**
IT1	My school has inadequate software and hardware for teaching and learning computer programming					
IT2	The availability of the internet will aid the teaching and learning of computer programming.					
IT3	There is enough technology equipment for the teaching and learning of computer programming.					
IT4	My school has the requisite IT infrastructure for the teaching of computer programming.					
IT5	My school is not yet ready for the implementation and teaching of computer programming.					
IT6	I get a quick response when I need a new computer device.					
	Organizational Support	**1**	**2**	**3**	**4**	**5**
OS1	My school has a strong commitment to developing and supporting the teaching of computer programming.					
OS2	Organizational structure, norms, and values play a key role in the teaching and learning of computer programming.					
OS3	Management supports initiatives of the ICT department to improve the teaching of computer programming.					
OS4	The success of the teaching of computer programming is dependent on the support of top management.					
OS5	Management supports the forming of a “Computer Programming Club” in my school to facilitate the extra tuition of computer programming.					
OS6	My school provides refresher training courses regularly to upgrade and improve my knowledge of computer programming.					

OS7	Management invests funds in the teaching of computer programming.					
	Motivation	**1**	**2**	**3**	**4**	**5**
M1	A well-equipped computer laboratory motivates me to teach computer programming.					
M2	The availability of relevant instructional materials motivates me to teach computer programming.					
M3	It is more difficult to do my job effectively because some of the devices I need are not available.					
M4	I lack the motivation to teach computer programming.					
M5	The presence or absence of opportunities for promotion, recognition, and career advancement does affect my motivation to teach computer programming in rural Ghana.					
M6	My school uses some other digital devices to enhance the teaching of computer programming.					
M7	Unfavorable lesson times demotivate me from teaching computer programming.					
	Policies	**1**	**2**	**3**	**4**	**5**
POL1	Policy-makers in the education sector do not consider rural areas in policy formulation.					
POL2	Educational policies are supported by empirical research data in their formulation and implementation, especially in teaching and learning computer programming in rural Ghana.					
POL3	The policy should be directed towards solving the inequalities in infrastructure (e.g. furnished ICT Laboratories, qualified IT personnel, etc.) among SHSs in Ghana.					
POL4	There are specific home-grown policies (by the PTA) in my school that support the ICT department in the effective teaching and learning of computer programming.					
POL5	There are specific policies aimed at improving and promoting teacher performance in teaching computer programming in my school (e.g., awards for the best programming teacher)					
POL6	There must be established policies at both the national and local levels towards the teaching of computer programming in rural Ghana.					
	Performance	**1**	**2**	**3**	**4**	**5**
PF1	Developing an interest in computer programming increases classroom delivery in the subject.					

PF2	Increased academic performance in computer programming is attributable to the smooth and flawless implementation.					
PF3	My background in Mathematics and Science increases my performance in teaching computer programming.					
PF4	Computer programming improves creative, and cognitive skills and increases the performance of students across different subject areas.					
PF5	The environment where programming lessons are held has a direct impact on the learning outcomes.					